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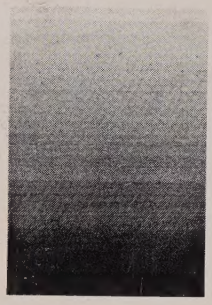

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Dash IV

Operations and Service

Manual

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DASH IV
Operations and Service Manual

Astro-Med, Inc.

Part Number

22834-004

Serial Number _____

Issued to _____

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Recorder Identification Data

Congratulations. Your Astro-Med purchase is an investment in the finest of state-of-the-art recorder technology. The information provided below lists the model number, serial number, and software version of your chart recorder. Verify that the software configuration number (SCN) of your chart recorder exactly matches the software version given below. (The SCN number appears in the top line of the recorder display when the [HELP] key is pressed.) The software version recorded below is the most current software version available for your chart recorder. As noted below, the software version number represents the software as originally installed in your instrument. Any upgrades of the chart recorder's resident software should be noted in the space provided. If, for any reason, it should be necessary for you to contact Astro-Med regarding your purchase, please refer to the following:

Model Number:_____

Serial Number:_____

Software Version:_____
(original installation)

Upgraded Software Version:_____
(date installed: ___/___/___)

Upgraded Software Version:_____
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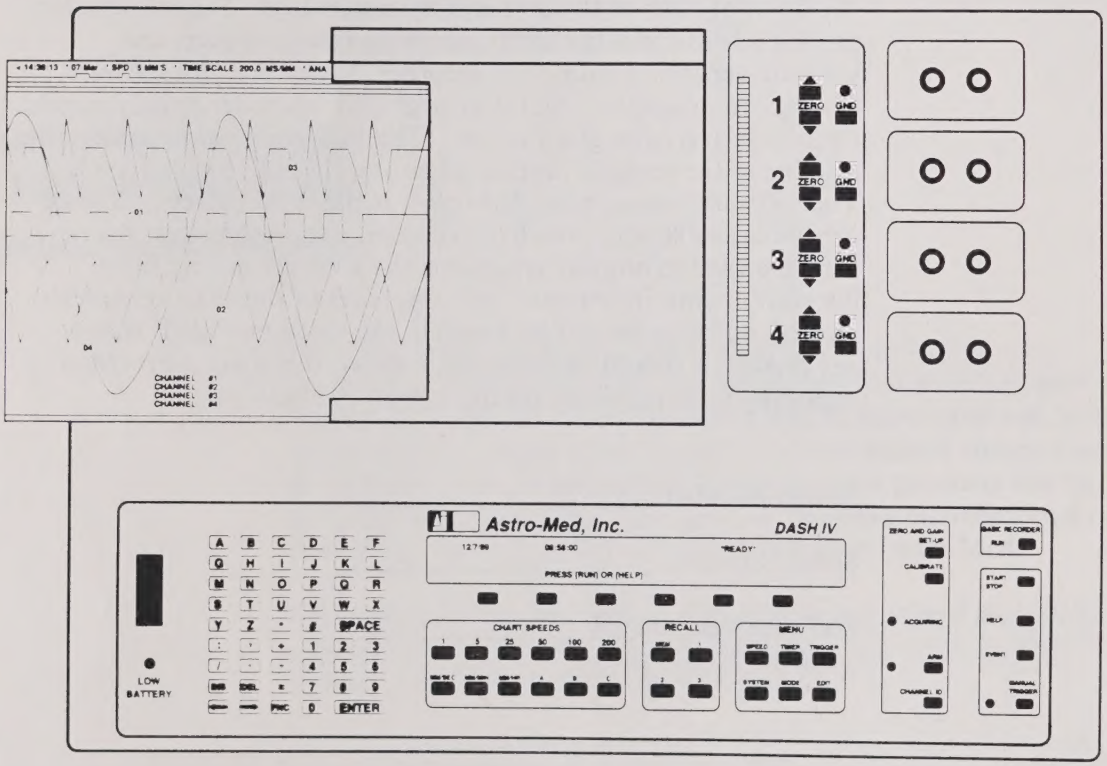

Astro-Med DASH IV Chart Recorder

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Section 1 Introduction

1-1 About This Manual

The purpose of this manual is to provide you with all the information required to operate your Astro-Med DASH IV four-channel field and laboratory chart recorder as a stand-alone instrument. DASH IV maintenance procedures are also presented in this manual. Control of your chart recorder through a remote host computer is discussed in the DASH IV Host Control Operations Manual.

This manual discusses all of the functions, features, and capabilities of your chart recorder. Separate sections of the manual discuss recorder preparation, recorder functions of immediate interest, operation, theory of operation, and maintenance.

1-2 Recorder Highlights

The DASH IV is the most recent addition to Astro-Med's extraordinary family of New Technology chart recorders. Integrating thermal printing, programmable memory, proprietary software, and solid state design, the DASH IV sets new standards of versatility and reliability for portable chart recorders. The inks, toners, mechanical styluses, and adjustments associated with older technology recorders have been eliminated. Consequently, routine maintenance and calibration requirements have been dramatically reduced.

A Commitment to Quality

Completely designed and built in the United States, the DASH IV is backed by Astro-Med's two-year warranty on both parts and labor.

Digitally processing incoming data with 10-bit accuracy, the DASH IV can simultaneously create any of several possible grids while printing waveforms directly onto thermal-paper rolls. Printing the waveforms and grid at the same time results in total correlation between the recorded waveforms and the selected grid. Data skew is simply eliminated. During recording, the DASH IV prints a System Log along the left edge of the chart. Invented by Astro-Med, the System Log automatically notes the exact time and date, the current time scale in ms/mm, and the current recording mode.

Unmatched Chart Clarity

The grids produced by the DASH IV can be instantly configured to print with either 5 major divisions and no minor divisions or with 5 major divisions and 25 minor divisions. If you desire, grid printing can be entirely suppressed. The DASH IV's 200 dots-per-inch resolution and thermal printing technology ensure that recordings are always smooth, clear, and accurate.

A crystal-referenced stepper motor drive system advances the chart paper through the recorder. Chart speed integers from 1 through 200 can be selected in time ranges of mm/hour, /minute, or /second.

Viewing of recorded data is immediate. There are no mechanical delays or delays associated with image development. The DASH IV's thermal printhead is located very close to the recorder's paper exit. The printing elements of the printhead are "near edge." This means that they are in close proximity to the printhead's edge and the paper exit.

Unmatched Chart Clarity (continued)

A bank of LED indicators (a "light bar") is located immediately to the left of the DASH IV's zero and ground controls. Using the same data as the printhead, the LED bar generates a dynamic view of waveform activity. The light bar is active even when the input signal is not being recorded. Clearly visible at a distance, the bar provides a convenient mechanism for monitoring waveform activity.

Depending on the recording mode, four channels of data can be recorded in:

- four 28.125mm channels
- two 56.25mm channels
- one 112.5mm channel
- one XY plot (two channels of data)
- four columns of tabular, numeric data

The order of the channels on the chart can be changed instantly with a few front-panel keystrokes. No cable rearrangement of any kind is required.

When the front-panel [CHANNEL ID] pushbutton is pressed, waveforms are immediately labelled with their respective channel number designations. This makes the identification of overlapped waveforms obvious and is useful in determining the order of separate channels that may have been rearranged.

Simple keystrokes permit immediate changes in recording format from separate channels to overlapped channels. When formats are changed, grid design automatically alters but calibration is retained.

Unexcelled Frequency Response and Accuracy

The DASH IV has an unexcelled real-time frequency response range of DC to 25 kHz. Frequency response is maintained without distortion, without reduction in amplitude, and without phase shift regardless of the selected sample rate.

The DASH IV has the extraordinary ability to calibrate itself on demand with a precision traceable to the requirements of the United States National Institute of Standards and Technology (NIST).

When the recorder's [CALIBRATE] key is pressed,

- each channel input is grounded.
- each baseline is labelled.
- an extremely precise reference voltage is input and labelled.
- internal adjustments are automatically made as necessary to exactly maintain the original zero and position selections.

Personality Modules

The DASH IV can be equipped with any of a complete line of signal conditioners called *Personality Modules.* Depending on the Personality Modules installed, the DASH IV can accept signals from 0 to 500 volts full-scale.

Gain and zero positioning are fully programmable. The front-panel [CALIBRATE] pushbutton causes the gain range and zero position of each channel to be printed directly onto the chart. The Personality Modules "talk," i.e., they automatically report their gain and position settings in the channel's annotation buffer. Generally, the last forty character spaces of the buffer are used for this pupose.

The menus displayed by the DASH IV can vary with the type of Personality Module installed. The menu structures discussed in this manual are based on the most widely used Personality Module, Astro-Med's General Purpose Personality Module, the PM-02.

Easy to Use Front Panel Features

Knobs and dials are completely absent from the DASH IV's front panel controls. Instead, the front panel provides a well organized and convenient array of soft-touch pushbutton controls. For convenience, the recorder's pushbutton controls are referred to as "keys" throughout this manual.

A generous alphanumeric keypad is provided for editing the instrument's 80-character annotation buffers. The keypad contains the full alphabet, numeric keys 0 through 9, punctuation and symbol keys, insert and delete keys, left and right arrow keys, a function key, and an enter key.

A liquid crystal diode (LCD) display provides two 40-character rows of highly visible menu selections and data entry readouts.

The DASH IV's front panel is equipped with many powerful keys providing rapid access to the recorder's most important programmable features. These keys are highlighted below.

The **[BASIC RECORDER RUN]** key causes the recorder to immediately enter basic real-time recording in four individual channels.

The **RECALL** keys provide three programmable keys each of which stores a complete system setup that can be implemented with a keystroke.

The **[HELP]** key results in a menu through which any of three help sheets can be immediately printed. These help sheets are: a QUICK START GUIDE TO OPERATION, GENERAL KEYPAD INFORMATION, and a Status Report that can provide full system status information on either the active system setup or any of three user-defined, recallable system setups.

The **CHART SPEED** keys to instantly access six preset speed increments and three time ranges. [A], [B], [C] keys can be programmed to chart speeds of your choice.

The **MENU** keys provide direct access to some of the recorder's most important menu setup parameters: [SYSTEM], [MODE], [EDIT], [TRIGGER], [TIMER], and [SPEED].

The **[EVENT]** key causes the system event marker to deflect to the left to mark data of interest.

The **[TRIGGER]** key allows data-capture snapshots or dual speed recording to be triggered from the front panel.

The **[ZERO AND GAIN SETUP]** and **[CALIBRATE]** keys provide menu-accessed adjustment controls for the recorder's built-in Personality Modules.

[ZERO] and **[GND]** soft keys for each of the recorder's four channels provide front-panel controls for zero baseline positioning and signal grounding.

The **[START STOP]** key provides a direct control that either halts recording or resumes recording.

Host Control and More

A GPIB (IEEE-488) port on the recorder's rear panel provides the connection that enables a host computer to control most DASH IV activities.

The extraordinary real-time recording performance of the DASH IV can be powerfully complemented with the recorder's Data Capture option (DC-45).

Real-time recording and data capture and playback recording are briefly described below. Section 4, "Operation," fully discusses each of the chart recorder's controls and modes.

1-3 Real-Time Recording Modes

The chart recorder has five real-time recording modes.

Continuous Real-Time Recording

Four channels of analog waveform data.

Timed Recording

Recording begins and ends at the dates and times that you specifically programmed.

Timed Dual-Speed Recording

Recording toggles between two user-programmed or default recording speeds at time intervals that you program or at default intervals.

Triggered Dual-Speed Recording

When a user-programmed trigger is sensed, recording toggles between two programmed or default recording speeds at time intervals that you specify.

Datalogger Recording

Waveform data is scaled and recorded as columns of user-defined engineering units.

1-4 Data Capture and Playback Modes

Data capture and playback require the installation of the Data Capture option (DC-45).

The chart recorder has five individually selectable sample rates: 2, 10, 50, 125, and 250 kHz per channel. This allows you to choose the sample rate that is most appropriate for your data. In most cases, sampling data at a rate approximately 10 times faster than than the highest waveform frequency provides excellent playback resolution.

In four-channel data capture, each recording channel has a data capture memory of 64 kilosamples (64k). In two-channel data capture, each of the selected channels has a data capture memory of 128 kilosamples (128k).

The chart recorder has the exceptional ability to perform data capture snapshots without interrupting ongoing real-time recording. This is referred to as "background data capture." Captured data is held until you specify a playback format and start the playback.

Captured data can be replayed in any real-time recording format: as separate channels, as overlapped waveforms, in datalogger format,or as an XY plot. The playback is labelled with time and date of capture, the time scale, and more.

Using the SET ACQ menu accessed from the [SYSTEM] key, you can select the amount of pretrigger data desired in the playback in $^{1}/_{16}$ increments.

Any percentage of the data snapshot can be replayed in any available format any number of times. In addition, the time scale resolution and effective chart speed of the playout can be expanded or compressed by factors of: x1, x2, x4, x8, ÷2, ÷4, ÷8.

Table 1-1.
Standard Features of the DASH IV

- DC to 25 kHz bandwidth
- 200 dot/inch printhead resolution
- 200 mm/second chart speed
- Four event markers

  - one system event marker
  - one marker switchable between event marker and timing marker
  - two standard event markers

- System Log reporting time, date, chart speed, time scale, and 30 user-programmable characters
- Self-printing HELP sheets that summarize recorder features and operations
- Overlap Modes

  two grids each containing two overlapped waveforms
  one grid containing four overlapped waveforms

- ID pushbutton to identify waveform channel; especially useful during overlap recording
- Alphanumeric printing

  four text buffers each with 80 character spaces

- Datalogger Mode

  scale each channel's waveform data for printing in numeric columns of user-selected engineering units

Table 1-1.
Standard Features of the DASH IV (continued)

- Remote Start / Stop

  permits external start/stop of recorder from TTL-low or switch closure

- Dual Speed mode causes recorder to alternate between two speeds based on trigger or time

- Three programmable insta-speeds

- Three programmable system setups

- Multiple grid formats printed with either:

  5 major divisions and no minor divisions (4-channel mode)
  5 major divisions with 25 minor divisions

- GPIB (IEEE-488) multi-user interface

- four separate A/D converters, 250 kHz/channel real-time sample rate, front panel gain selection, host programmable

- Start-up kit with one roll of thermal chart paper

- Operations and Maintenance manual

- AC power cord

Table 1-2.
Physical / Functional Specifications

Dimensions	17 ½" (445mm) wide 5 ¼" (133mm) high 12 ½" (317mm) deep
Weight	26 pounds (12 kg) with battery pack
Power Requirements	DC: 11 - 16 VDC Line: 115/230 VAC 50/60 Hz Fuse: 115 V, 2 amps (250 V) 230 V, 1 amp (250 V)
Recording Method	Thermal direct-writing. Resolution: 200 dots/inch
Paper	Low-cost, permanent, black-imaging roll thermal paper
Paper Width	5.53" (140.5mm)
Paper Length	150' (45.7m)
Number of Channels	four
Trigger LED	Located opposite the [TRIGGER] key, this LED illuminates when any valid trigger occurs.
Low Battery Indicator	Illuminates to indicate that battery pack requires charging.

Table 1-2.
Physical / Functional Specifications (continued)

Event Markers	Four: • 1 system event marker • 1 marker switchable in function from event marker to timing marker • 2 standard event markers *actuated by front-panel control, internal timer switch TTL low, switch closure, or host control command* Up to 4 additional event markers can be added with the EM-44 option. Actuated by TTL low, switch closure, or host control command.
Interchannel Annotation	standard: 4 text buffers each containing 80 character spaces ASCII characters entered via front panel keypad. Complete ASCII character set can be entered via host computer.
"Talking" Personality Module Annotation	Gain and zero position settings automatically printed in the last 40 character spaces of the interchannel text buffers. Reporting for each channel can be separately turned on or off.
System Log Printing	Time, date, chart speed, time scale, recording mode, and 30 user-addressable characters printed in a "System Log" along the left edge of the chart paper.

Table 1-2.
Physical / Functional Specifications (continued)

Other Printing	ID pushbutton: each waveform labeled with appropriate channel number
Real-Time Sample Rate	250 kHz per channel
Real-Time Bandwidth	DC to 25 kHz, <3 dB
Resolution	10 bits per channel
Chart Visibility	¼-inch from print line to waveform visibility. Built-in LED light array provides continuous real-time presentation of waveforms.
Grid Printing	Simultaneous with waveform. Eliminates data skew.
Grid Selections	5 major divisions 25 minor divisions on/off • Grid printing on/off • Four separate 28mm-wide grids each containing an individual waveform • Two 56mm-wide grids each containing two overlapped waveforms • One 112.5mm-wide grid containing four overlapped waveforms

Table 1-2.
Physical / Functional Specifications (continued)

Real-Time Recording Modes	Continuous real-time recording. Dual Speed recording based on time. Dual Speed recording based on trigger. Timed operation: start and stop at programmed times.
Data Capture Modes (DC-45 option required)	Instant Capture and Replay playback in selected replay mode (any format available in real-time recording). manual or automatic rearming of trigger. Background Capture and Delayed Replay performs capture and retains in memory for later replay; real time recording continues without interruption.
Data Capture RAM (optional)	4-channel data capture: 64 kilosamples total memory per channel 2-channel data capture: 128 kilosamples total memory per channel
Pre-Trigger Selections	Selectable in $\frac{1}{16}$ increments from $\frac{1}{16}$ to $\frac{15}{16}$
Best Time Scale Resolution	12.5 µs/mm (x8 expansion) Time scale resolution, effective chart speed, expansion and compression factors automatically printed on chart.

Table 1-2.
Physical / Functional Specifications (continued)

Expansion / Compression Factors	x1, x2, x4, x8, ÷2, ÷4, ÷8
Trigger Identification	Event marker on right edge of chart indicates trigger location within the replayed data.
Data Capture Sample Rates	Selectable from: 2, 10, 50, 125, 250 kHz per channel
Data Capture Quantization	10 bit
Background Data Capture	Real-time recording continues uninterrupted during data capture.
Event Markers	If desired, event markers can be captured and replayed with snapshots.
Additional Modes	Datalogger Operation: four columns of user-scalable engineering units.
A/D Converters	1 per channel
Analog Inputs	One set of front-panel Personality Module signal-input connections for each signal conditioner.

Table 1-2.
Physical / Functional Specifications (continued)

Computer Interface	IEEE-488 (GPIB) Multi-User Parallel Interface address selections from 0 to 30
Chart Speeds from Keypad	1 mm/hr to 200 mm/sec Every integer from 1 through 200 selectable in mm/hr, mm/min, mm/sec time ranges
Chart Speeds from Discrete Keys	• six integer selections: 1, 5, 25, 50, 100, and 200 • other speeds available through alphanumeric keypad • range keys: mm/sec, mm/min, mm/hr • programmable [A], [B], [C] insta-speed keys
Motor Type	Crystal referenced stepper motor
Power On / Off Switch	Toggles between applying power to and removing power from the recorder.
Recall Section	[MEM], [1], [2], [3] keys invoke three preprogrammed and complete system setups.

Table 1-2.
Physical / Functional Specifications (continued)

Menu Section	[SPEED] key accesses the menu to specify any desired chart speed. [TIMER] key accesses the menu to select the timing mark interval. [TRIGGER] key accesses the menu to specify all trigger condition parameters. [SYSTEM] key accesses the menu to specify all system setups, e. g., channel order, time, date, etc. [MODE] key accesses the menu to select the operating mode. [EDIT] key accesses the menu to edit the interchannel text buffers.
Channel Section	[ZERO AND GAIN SET-UP] key accesses the menu for specifying gain and zero positions of all channels. [CALIBRATE] key causes precise, automatic calibration signals to be sent to each channel. Prints gain and zero settings on the chart. Calibration signal traceable to requirements of the U.S. National Institute of Standards and Technology (formerly NBS) ACQUIRING LED illuminates during data captures.

Table 1-2.
Physical / Functional Specifications (continued)

Channel Section (cont.)	ARM LED illuminates when background data capture is armed. [CHANNEL ID] key causes immediate printing of appropriate channel number on each waveform.
Operation Section	[BASIC RECORDER RUN] key immediately initiates real-time recording in the 4-channel mode. [START STOP] key stops or re-initiates ongoing printing. [HELP] key results in a menu through which any of three help sheets can be immediately printed. These help sheets are: QUICK START GUIDE TO OPERATION, GENERAL KEYPAD INFORMATION, and a Status Report that provides full system status information on either the active system setup or any of three user-defined, recallable system setups. [EVENT] key causes system event marker to deflect to the left to mark data of interest. Marker returns to the right when key is released. [TRIGGER] key provides a front-panel mechanism for manually triggering a data capture snapshot or dual speed recording.

Table 1-3.
Options for the DASH IV Recorder

DC-45	Data Capture Provides four channels of high speed data capture and slow motion playback of waveform data. Provides: • five individually selectable sample rates: 2, 10, 50, 125, and 250 kHz per channel. • 64k sample memory buffer per channel. • pretriggering data in $\frac{1}{16}$ increments. • event marker capture. • capture can occur in background leaving real-time recording uninterrupted. • 2-channel data capture supplying each channel with 128k sample memory
EM-95	Event Marker Provides 4 event markers that can be actuated through a TTL low or switch closure. These event markers are in addition to the 4 event markers that are standard on the DASH IV. Utilizes rear-panel 15-pin D-shell connector.

Table 1-3.
Options for the DASH IV Recorder (continued)

BP-40	Battery Pack Internal, nickel-cadmium, 12-volt battery pack. Automatically charged during AC operation.
RD-950	Remote Drive Allows external control over chart motor stepping via TTL source. Maximum 800 Hz (50 mm/sec)

Section 2 Recorder Preparation

2-1 Before Operating Your Recorder

Your DASH IV requires very little setup. After you have unpacked the DASH IV, examine the recorder's condition and verify that no obvious shipping damage has occurred.

In addition to the DASH IV itself, you should find the following items:

- This DASH IV Operations and Service Manual
- One power cord
  (stored within the recorder's top cover)

  No power cord is furnished for shipments outside the United States due to varying power requirements between countries.
- One roll of Astro-Med thermal paper
- One 3-contact auxiliary power plug for use with the external input 11-16 VDC connection*
- One 15-pin D-shell connector for use with the recorder's rear-panel UTILITY input*

  *Cable to be supplied by customer

In most cases the DASH IV is shipped with the Personality Modules of your choice already installed. There may be instances in which you will want to install or remove a Personality Module. In these instances, see "Personality Module Replacement / Removal" in Section 6, "Maintenance."

The DASH IV can be operated using any of three power sources:

- line voltage

  115 VAC, 50/60 Hz
  230 VAC, 50/60 Hz

- external 11 - 16 VDC

- optional, internally-mounted, 12-volt rechargeable NiCad battery pack

- optional, external 22 - 32 VDC
  (*replaces optional battery pack)*

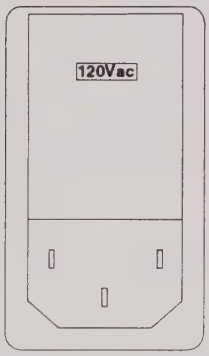
If you will be using external DC voltage to power the DASH IV, you will have to wire the 3-contact plug supplied for use with the recorder's external 11 - 18 VDC receptacle. See "Wiring the 3-Contact Auxiliary Power Plug" in paragraph 2-3 of this Section.

If you will be using line voltage to power the DASH IV, see paragraph 2-2, "Quick Setup of the DASH IV," below.

Verify Correct Line-Voltage Setting

Before connecting your DASH IV to any line-power outlet, verify that the recorder is set to the line voltage applicable to your needs - either 115 VAC or 230 VAC. The appropriate voltage has been factory-set to your requirements and should not need immediate adjustment. If you want to change the recorder's line voltage, see "Changing the Recorder's Line Voltage Setting" in Section 6 of this manual.

To check the line voltage setting, check the rear-panel voltage selection indicator.



2-2 Quick Setup of the DASH IV

1

After your recorder has been examined, connect the AC power cord:

- first to the rear-panel power input receptacle (beneath the right hinge of the rear panel)
- then to a power source.

DC: 11 - 16 VDC

Line: 115/230 VAC
50/60 Hz

Fuse: 115 V, 2 amps (250 V)
230 V, 1 amps (250 V)

2

Load the recorder with the roll thermal paper that has been supplied. The paper compartment is located to the left of the DASH IV's light bar.

- Press down on the latch that secures the paper compartment door.

  A small pneumatic piston strut automatically opens the door and holds it open. This eliminates any possibility of printhead damage due to the door dropping shut. It also makes the simple process of paper-loading even easier.

- Insert the roll so that the paper unwinds from the bottom of the roll.

- Pull out approximately six inches of paper and close the paper compartment door. A latch will secure the door.

3

Push the POWER switch to the "ON" position.

When the DASH IV has been powered up:

- a self-test sequence is quickly completed.

- the instrument begins recording in the format and mode used during the last recording activity.

  For example, if the DASH IV had been operating in the 4-channel overlap mode when it was turned off, it will resume operation in the 4-channel overlap mode when turned on.

If problems are encountered during the recorder's self-test sequence, error messages may appear on the front-panel display. Error messages may include any of the displays shown on the next page.

If your DASH IV should display an error message, call Astro-Med's service department at (401) 828-4000.

Error Messages Possible Upon Recorder Power-Up

* SELF-TEST FAILED *
* UTILITY BOARD RAM ERROR *

* SELF-TEST FAILED *
* UTILITY BOARD DUALPORT ERROR *

* SELF-TEST FAILED *
* UTILITY BOARD CPU ERROR *

* SELF-TEST FAILED *
* UTILITY BOARD INT CNTL1 ERROR *

* SELF-TEST FAILED *
* UTILITY BOARD INT CNTL2 ERROR *

* SELF-TEST FAILED *
* CPU BOARD RAM ERROR *

* SELF-TEST FAILED *
* CPU BOARD CPU ERROR *

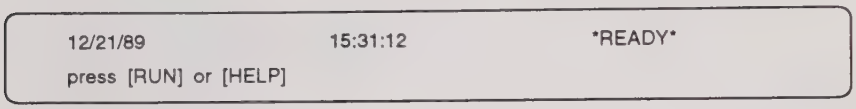
* SELF-TEST FAILED *
* CPU BOARD PIT ERROR *

* SELF-TEST FAILED *
* CPU BOARD INVALID FLASH *

* SELF-TEST FAILED *
* CPU – UTILITY LINK ERROR *

Recorder Base Display

As described in Section 4, "Operation," many menus offer EXIT options that return the DASH IV to a recorder base display. The base display will be very similar to the sample below.



Throughout this manual, this display is referred to as the chart recorder's base display. Note that this display informs you of the current date, the current time, and the recorder's READY status. The display also lets you know that you can immediately begin 4-channel real-time recording simply by pressing the front-panel [BASIC RECORDER RUN] key. In addition, the display reminds you that the front-panel [HELP] key provides you with immediate sources for concise operating instructions and system status data.

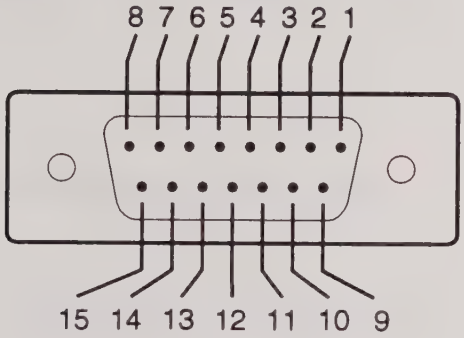
This message will remain displayed until the recorder's setup or mode keys are used to invoke subsequent menu displays.

Testing Waveform Recording

If you want to test the the waveform recording capabilities of your chart recorder, you can do so now. The simplest way to accomplish this is to connect one or more signal sources to the Personality Module signal inputs on the recorder's front panel.

2-3 Wiring the 15-Pin D-Shell Connector

A 15-pin D-shell connector is provided for use with the DASH IV's UTILITY D-shell receptacle. The table below identifies each pin and its related function.



Description	Pin #
Event 1	1
Event 2	2
Event 3	3
Event 4	4
System Event 1	5
System Event 2	6
System Event 3	7
System Event 4	8
External Trigger	9
External Speed	10
Remote Start/Stop	11
Ground	12
no connection	13
no connection	14
no connection	15

Section 3 Recorder Functions of Immediate Interest

3-1 After Preparing Your Recorder

This section provides concise descriptions of fifteen real-time and data capture procedures that may be of immediate operator interest.

Real-Time Operations

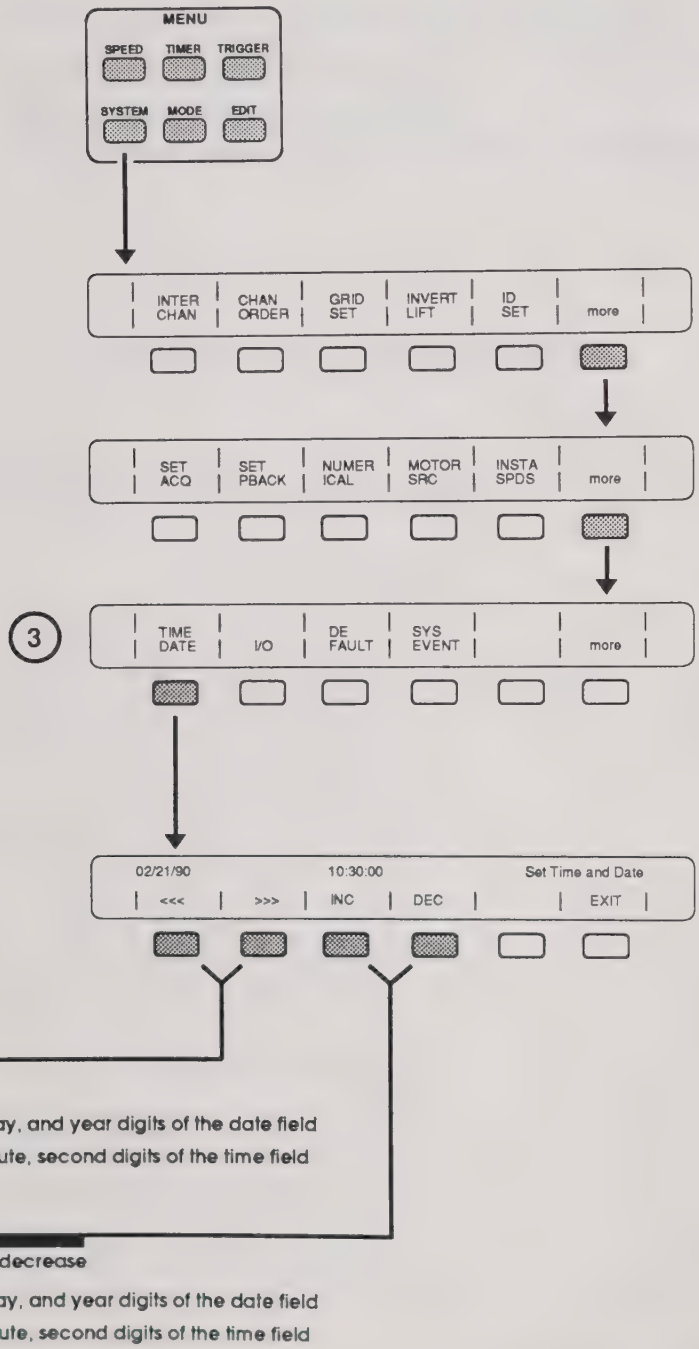
- Verifiying the Recorder's Time and Date Settings
- Setting All Recording Parameters to System Default Values
- Initiating a Recorder Self-Calibration
- Initiating Basic Four-Channel Recording
- Halting / Resuming Recording
- Marking Data of Interest
- Establishing Zero and Gain Settings
- Grounding the Trace and Shifting the Zero Baseline
- Changing Recording Modes
- Changing Recording Speeds
- Changing the Annotation in an Interchannel Buffer
- Asking the Recorder for Help

Data Capture Operations

- Setting Up for a Manual Trigger
- Defining a Data Snapshot Window
- Defining a Data Snapshot Playback

For full information regarding these procedures, refer to Section 4, "Operation."

3-2 Verifying the Recorder's Time and Date



The Sequence of Steps

1. Press the [SYSTEM] key of the MENU group.

2. Proceed to Level 3 of the [SYSTEM] key menus.

3. Press the soft key beneath "TIME/DATE."

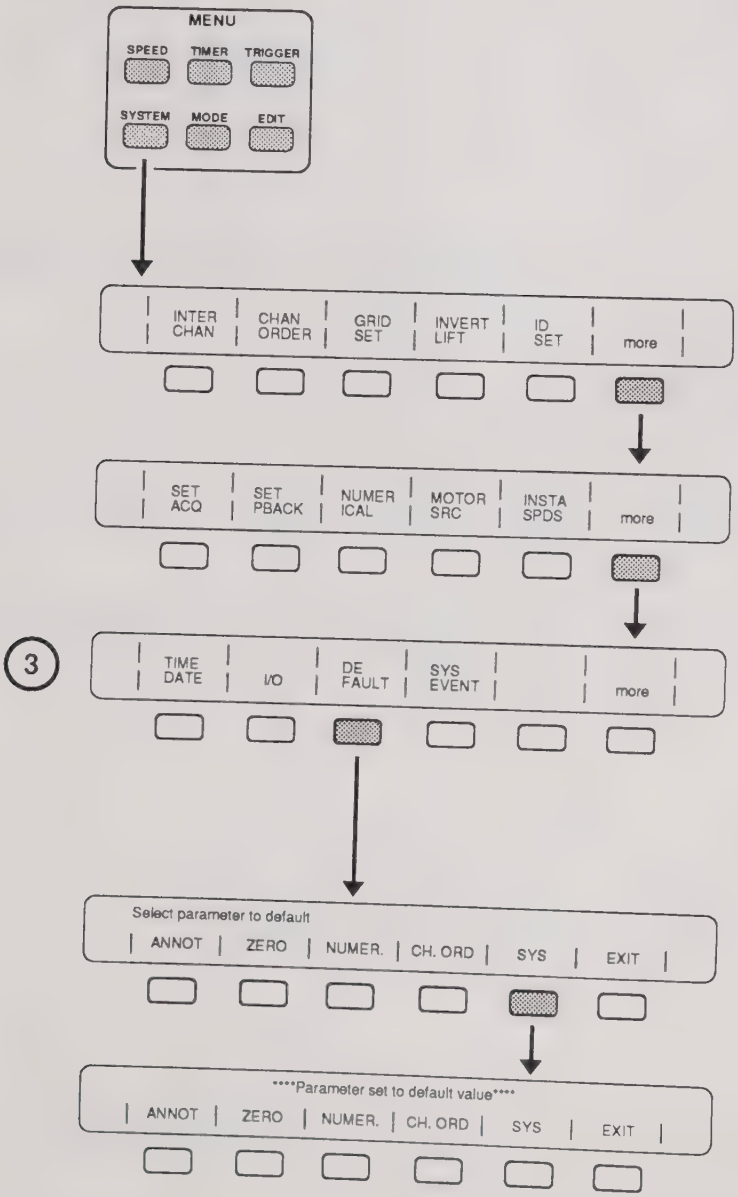
   The resulting display will show you the time and date. If either the displayed time or date is incorrect, reset it as described in steps 4 and 5 below.

4. Use the soft keys beneath "<<<" and ">>>" to individually select each numeric pair of the displayed time or date.

5. When the numeric pair you want to change is selected, use the soft keys beneath either "INC" or "DEC" to increase or decrease it.

6. When the correct time and date have been set, press the soft key beneath "EXIT" to return to Level 3 of the [SYSTEM] key menu.

3-3 Setting All Recording Parameters to System Default Values



The Sequence of Steps

1. Press the [SYSTEM] key of the MENU group.

2. Proceed to Level 3 of the [SYSTEM] key menus.

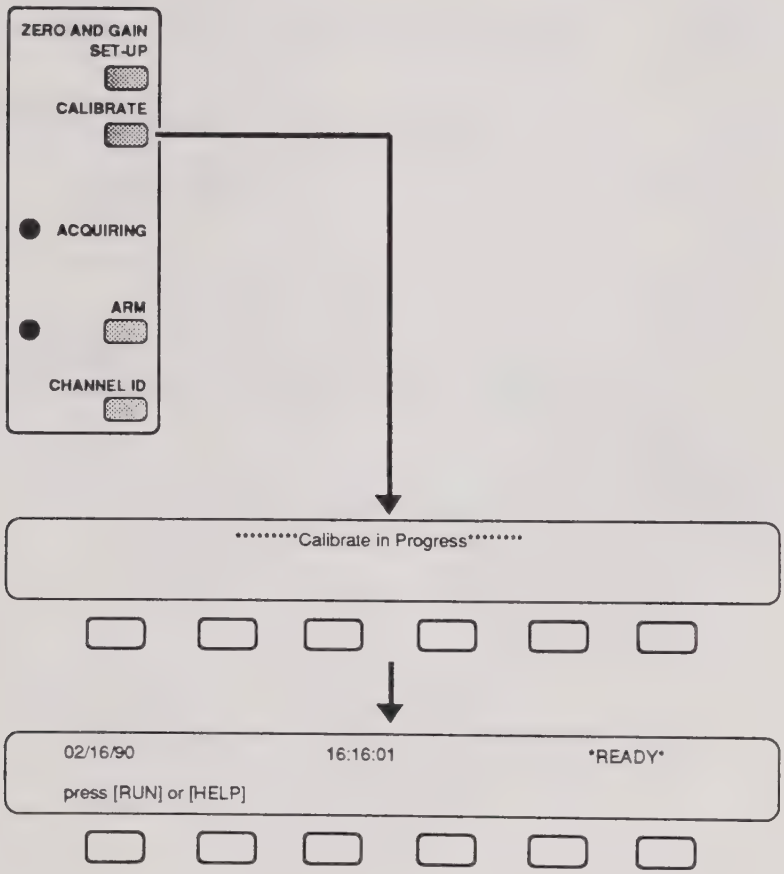
3. Press the soft key beneath "DEFAULT."

4. Press the soft key beneath "SYS."

   A message will be briefly shown indicating that the "parameter" (in this case, all system parameters) has been set to its default value.

5. Press the soft key beneath "EXIT" to return to Level 3 of the [SYSTEM] key menu.

3-4 Initiating a Recorder Self-Calibration



The Sequence of Steps

1 Press the [CALIBRATE] key of the Operation group.

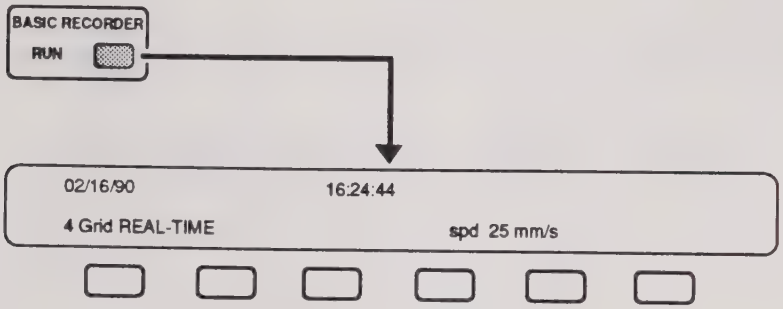
2 A temporary message will automatically appear indicating that a recorder calibration is in progress.

When the chart recorder's [CALIBRATE] key is pressed:

- *each channel input is grounded.*
- *an extremely precise reference voltage is input and labelled.*
- *internal adjustments are made as necessary to exactly maintain the original zero and position selections.*
- *each baseline is labelled.*

3 After the calibration process has been completed, the recorder returns to its base display.

3-5 Initiating Basic Four-Channel Real-Time Recording



1 Press the [BASIC RECORDER RUN] key.

The recorder immediately begins recording four channels of real-time analog waveform data.

The date, time, mode, and chart speed are shown in the LCD display.

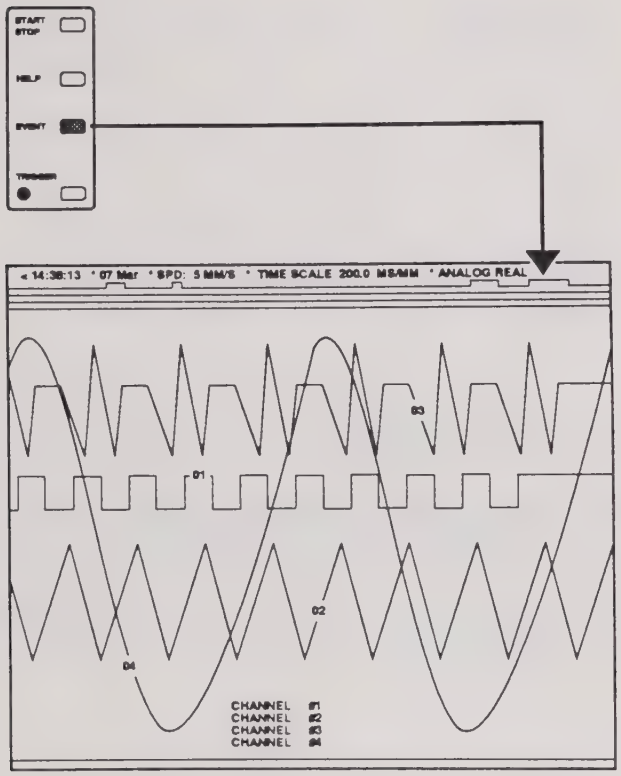
3-6 Halting / Resuming Recording

1 Press the [START STOP] key of the Operation group.

If recording is ongoing, chart output is stopped and the word "halted" appears in the front-panel LCD display.

If recording is already halted, recording will resume when the [START STOP] key is pressed.

3-7 Marking Data of Interest

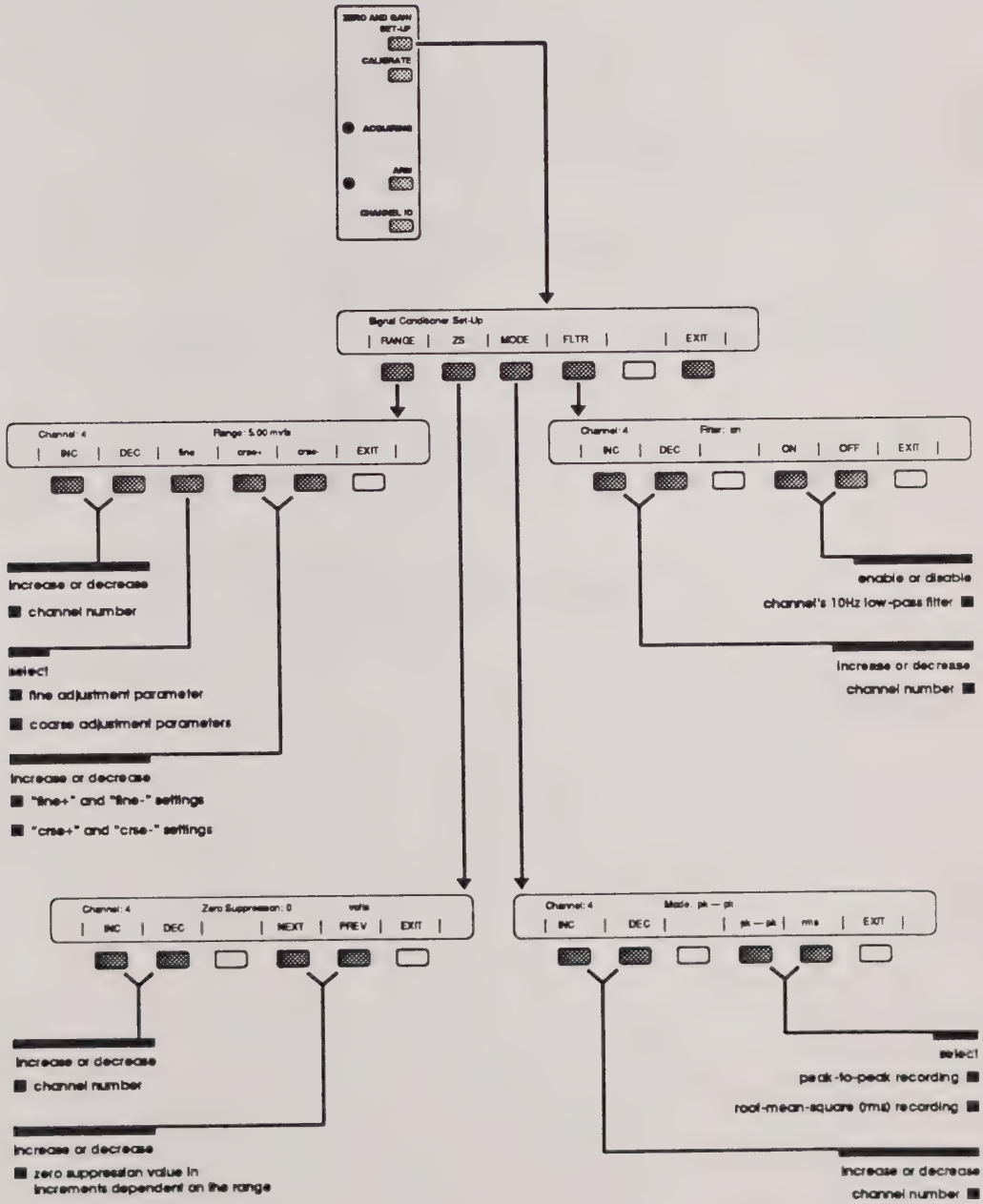


1 Press the [EVENT] key of the Operation group.

The System Event Marker toggles toward the left edge of the grid to indicate data of interest.

When the [EVENT] key is released, the event marker stops deflecting and returns to its previous position.

3-8 Establishing Zero and Gain Settings



The Sequence of Steps

1. Press the [ZERO AND GAIN SET-UP] key of the Signal Conditioner group.

   The Signal Conditioner Set-Up menu will appear on the front panel LCD dispaly

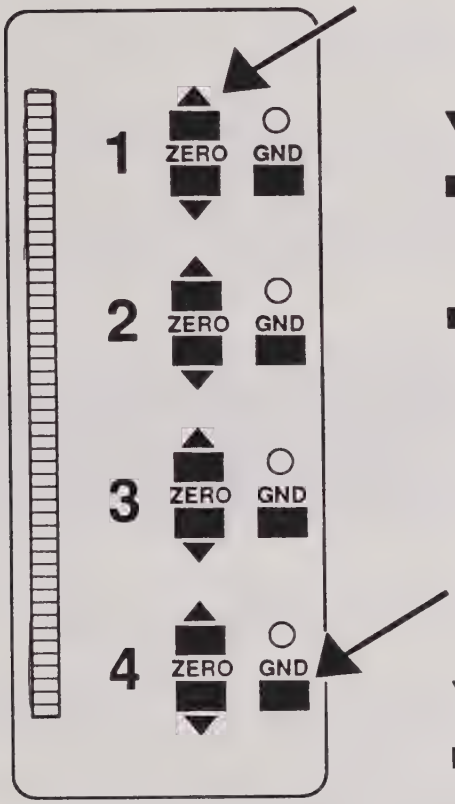
2. Press the soft key beneath "RANGE" to adjust the full-scale voltage range of the selected channel.

3. Press the soft key beneath "ZS" to adjust the zero suppression setting of the selected channel.

4. Press the soft key beneath "MODE" to choose between either Peak-to-Peak or root-mean-square (rms) recording methods.

5. Press the soft key beneath "FLTR" to enable or disable the 10 Hz low-pass filter of the selected channel.

3-9 Grounding the Trace and Shifting the Zero Baseline



▼ Press

■ the "up" (ZERO) key to shift selected waveform to channel's left edge.

■ the "down" (ZERO) key to shift selected waveform to channel's right edge.

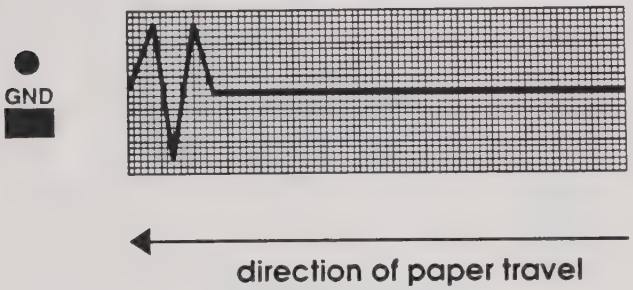
▼ Press

■ (GND) key of the selected channel to ground waveform trace.

grounding the waveform signal

1 Press the [GND] key of the channel for which you want the waveform on the trace grounded.

The waveform signal becomes a flat-line trace and the LED associated with the grounded channel illuminates.



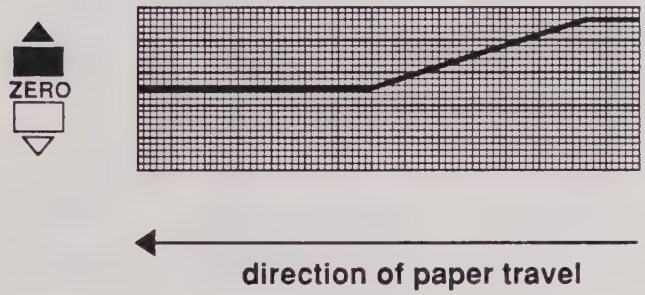
2 To recover the waveform trace, press the [GND] key again.

The waveform trace is recovered and the LED associated with the grounded channel is no longer illuminated.

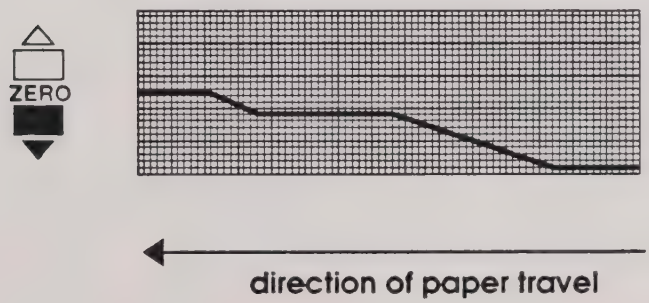
shifting the zero baseline

1 Press the [ZERO] key associated with the direction in which you want the waveform shifted.

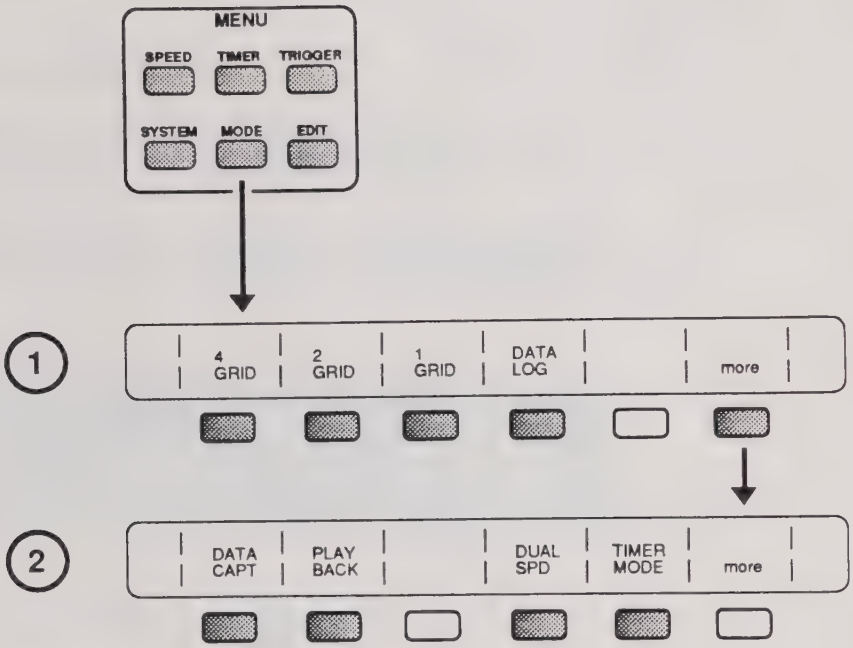
The "up" [ZERO] key shifts the waveform towards the left edge of the channel grid. The example shows the shifting of a grounded, flat-line trace.



The "down" [ZERO] key shifts the waveform towards the right edge of the channel grid. Again, a grounded, flat-line trace.



3-10 Changing Recording Modes



The Sequence of Steps

1 Press the [MODE] key of the MENU group.

Level 1 of the [MODE] key prime menu is displayed.

2 Press the soft key beneath the mode in which you want the DASH IV to record.

4 GRID immediately enters the recorder into real-time recording in four 28.125mm-wide channels each containing a single waveform. Recording reflects either custom presets defined using the [SYSTEM] key or default presets if default values have not been changed.

2 GRID immediately enters the recorder into real-time recording in two 56.25mm-wide channels each containing two waveforms. Recording reflects either custom presets defined using the [SYSTEM] key or default presets if default values have not been changed.

1 GRID immediately enters the recorder into real-time recording in one 112.5mm-wide channel containing four overlapped waveforms. Recording reflects either custom presets defined using the [SYSTEM] key or default presets if default values have not been changed.

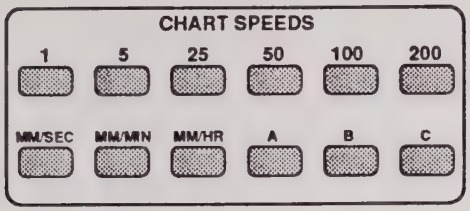
DATALOG immediately enters the recorder into Datalogger operation reflecting the values specified in the NUMERICAL setup of the [SYSTEM] key.

3 Press the soft key beneath "more" to invoke Level 2 of the [MODE] key prime menu.

4 Press the soft key beneath the mode in which you want the DASH IV to record.

DATA CAPT	invokes the menu that initiates the data capture mode. The capture reflects either custom presets defined using the SET ACQ menus of the [SYSTEM] key or default presets.
PLAYBACK	immediately inititates playback of a data capture acquisition. The playback reflects either custom presets defined using the SET PBACK menus of the [SYSTEM] key or default presets.
DUAL SPD	enters the recorder into either timed dual speed operation, triggered dual speed operation, or a combination of both.
TIMER MODE	enters the recorder into timed operation.
more	invokes Level 1 of the [MODE] key prime menu.

3-11 Changing Recording Speeds



The Sequence of Steps

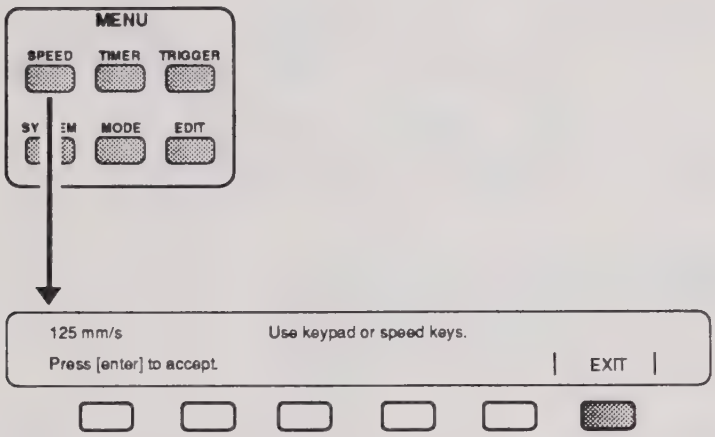
using the CHART SPEEDS group

1 Press the [1], [5], [25], [50], [100], or [200] key to immediately implement the selected speed while retaining the ongoing range (MM/SEC, MM/MIN, MM/HR).

2 Press either the [A], [B], or [C] key of the bottom row to immediately implement the "insta-speed" value of the selected key.

The speed will either be the default value of the insta-speed key or will be a programmed speed defined by the user.

3-11 Changing Recording Speeds (continued)



The Sequence of Steps

using the [SPEED] key

1 Press the [SPEED] key of the MENU group.

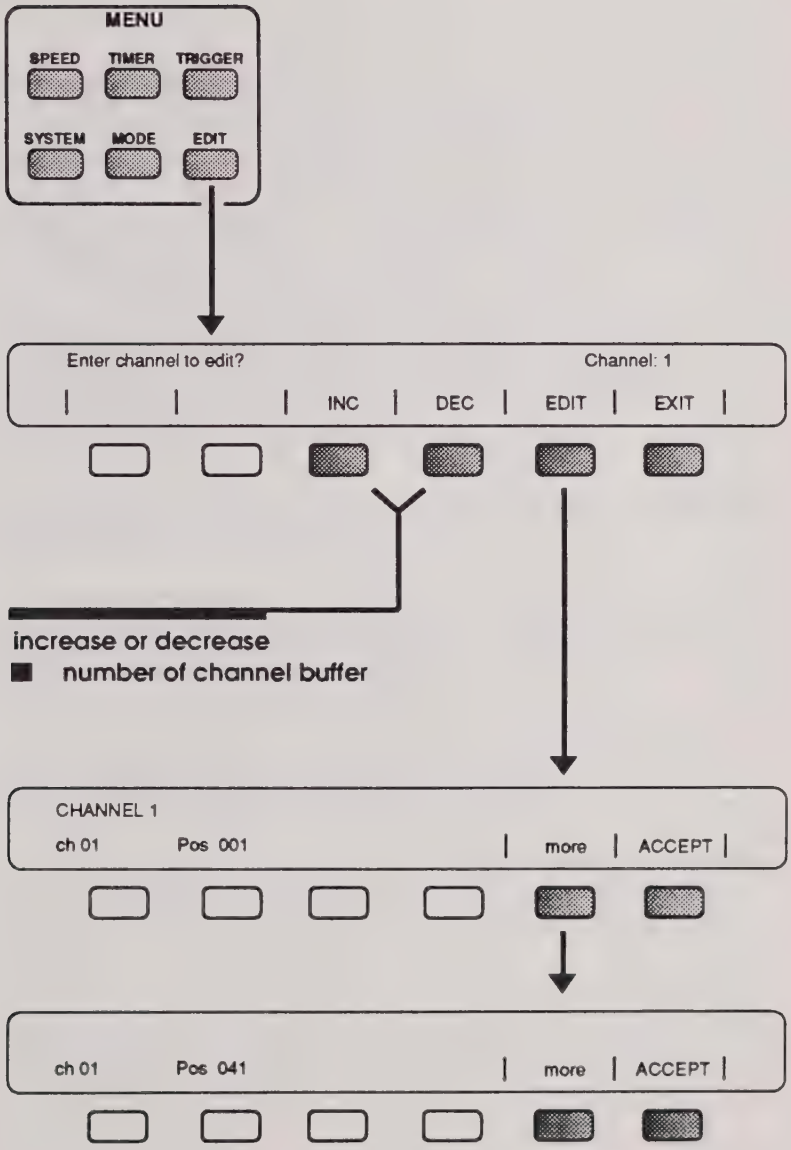
The speed menu is automatically invoked.

2 Use the alphanumeric keypad to enter the speed you want.

3 Press the [ENTER] key of the alphanumeric keypad to have the DASH IV accept the speed. When you press [ENTER], the recorder accepts the speed and returns to the front-panel base display.

4 Press the "EXIT" key before the speed has been entered to abort the chart speed change and return the recorder to its base display.

3-12 Changing the Annotation in an Interchannel Buffer



The Sequence of Steps

selecting an interchannel buffer to edit

1. Press the [EDIT] key of the MENU group.

   The "Enter channel to edit" menu is automatically invoked.

2. Press the soft key beneath "INC" to change the number of the buffer to be edited to the next higher number.

   The channel number parameter is automatically selected and flashing when the [EDIT] key is pressed. This indicates that it is ready to be changed. In addition to the individual interchannel buffers, the System Log can be selected for editing.

3. Press the soft key beneath "DEC" to change the number of the buffer to be edited to the next lower channel number.

4. Press the soft key beneath "EDIT" to invoke the menu required to access any space within the 80-character interchannel buffer and enter or delete information in that space.

5. Press the soft key beneath "EXIT" to return to the recorder's base display.

editing an interchannel buffer

1 Press the soft key beneath "EDIT" to display the menu listing the first forty characters of the interchannel buffer.

The current contents of the buffer are listed across the top level of the display. The first character of the display is automatically selected and flashing. This indicates that it can be changed.

The bottom level of the display indicates the channel number of the interchannel buffer being shown. The "Pos" (position) parameter indicates the number of the interchannel buffer space (001 - 80) currently selected.

2 Use the alphanumeric keypad to enter the characters of your choice in the buffer.

The right arrow key of the alphanumeric keypad moves to the right through each space of the displayed interchannel content selecting each character for change.

The left arrow key of the alphanumeric keypad moves to the left through each space of the displayed interchannel content selecting each character for change.

The [DEL] key of the alphanumeric keypad deletes any currently selected character. If the [DEL] key is pressed and held, any currently selected character and all characters to its right will be deleted.

The [INS] key of the alphanumeric keypad allows you to select any position from within the buffer and insert data from that point.

editing an interchannel buffer (continued)

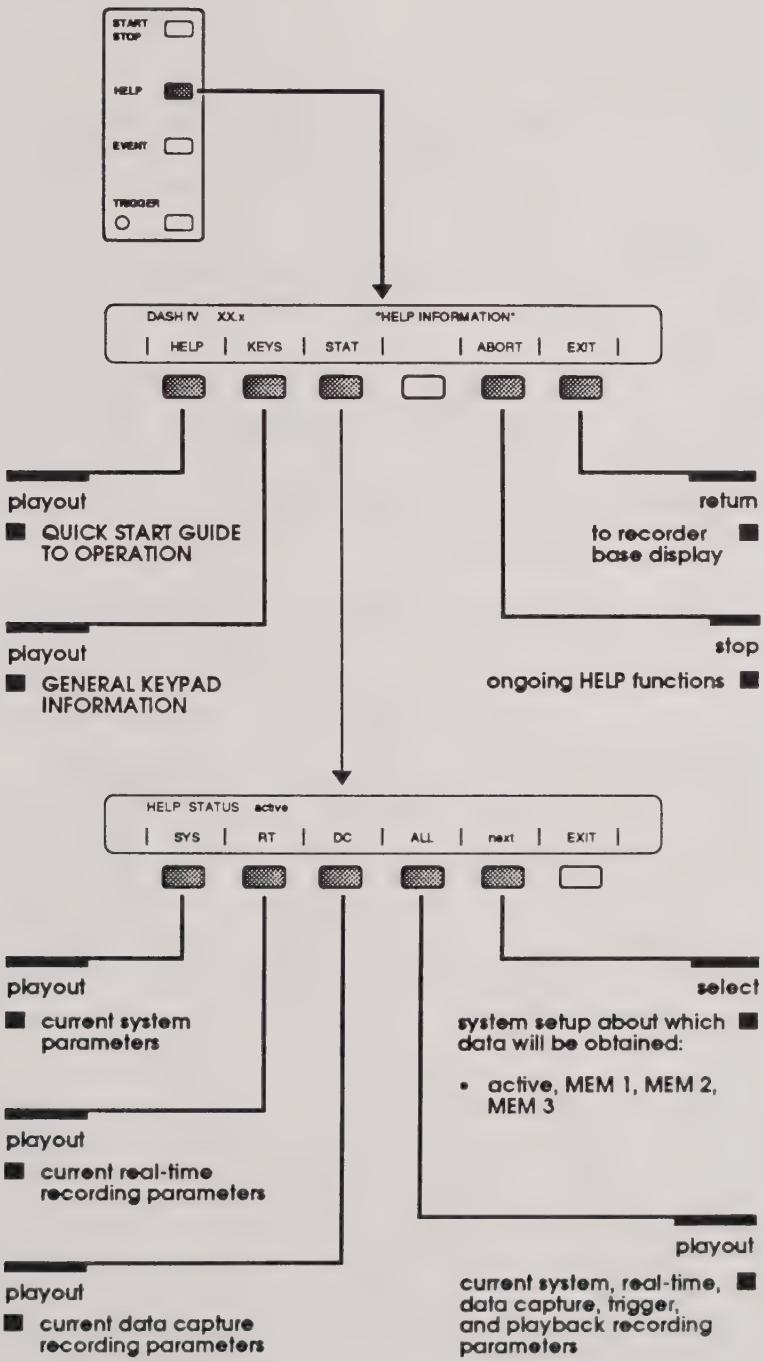
3 Press the soft key beneath "more" to display the remaining forty characters of the interchannel buffer.

Edit these characters with the alphanumeric keypad as described in step 2.

4 Press the soft key beneath "ACCEPT" to have the DASH IV accept the newly edited content of the interchannel buffer.

This content will be printed on the chart when the annotation option is selected for the particular buffer. If you do not press "ACCEPT," no change will be made to the current content of the buffer.

3-13 Asking the Recorder for Help



The Sequence of Steps

the initial HELP menu

1 Press the [HELP] key of the Operations group.

The initial HELP menu is invoked.

2 Press the soft key beneath "HELP" to prompt the recorder to print a QUICK START GUIDE TO OPERATION.

3 Press the soft key beneath "KEYS" to prompt the recorder to print a GENERAL KEYPAD INFORMATION sheet.

4 Press the soft key beneath "STAT" to invoke the menu used to prompt the recorder to print:

- the current system setup parameters.
- the parameters of any of the three system setups stored in the RECALL group's MEM keys.

5 Press the soft key beneath "ABORT" to immediately stop and exit from the printout of any ongoing HELP or status sheet information.

6 Press the soft key beneath "EXIT" to return to the recorder's base display.

The Sequence of Steps

the [HELP] key STAT submenu

1. Press the soft key beneath "SYS" to obtain an immediate printout of current system parameters.

2. Press the soft key beneath "RT" to obtain an immediate printout of current real-time recording parameters.

3. Press the soft key beneath "DC" to obtain an immediate printout of current trigger, acquisition, and playback parameters.

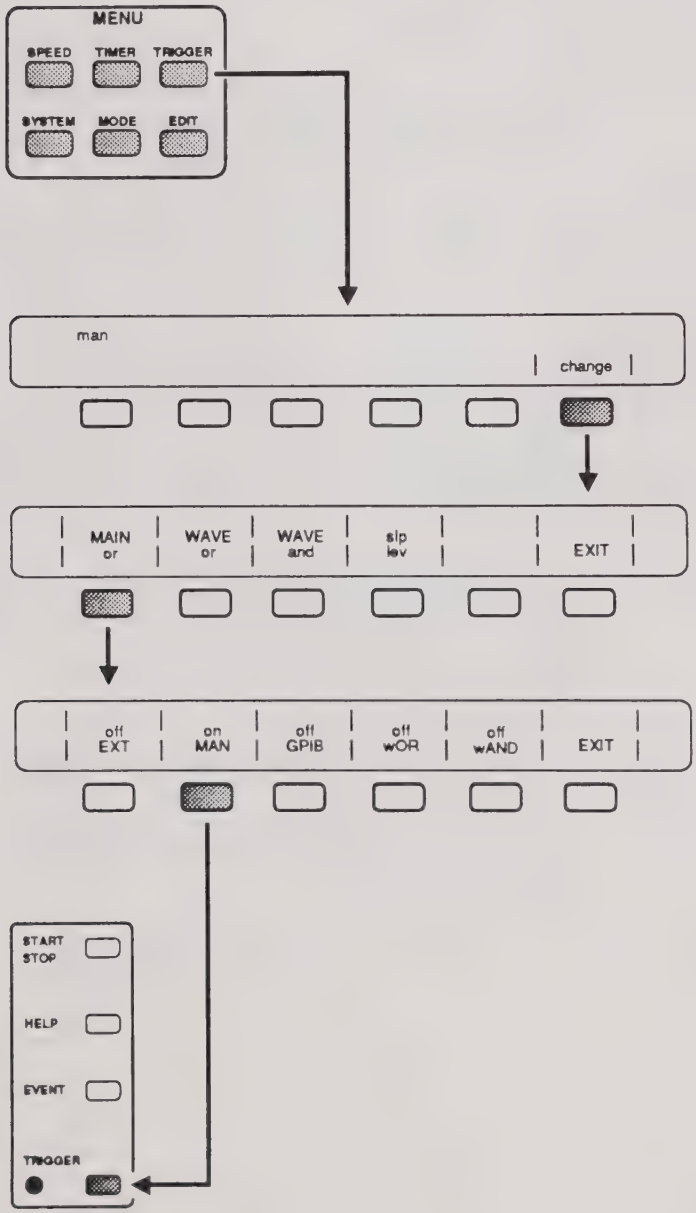
   If the Data Capture option (DC-45) is not installed in your recorder, this parameter will read "TRIG." In this case, the resulting printout will consist of current trigger settings.

4. Press the soft key beneath "ALL" to obtain an immediate printout of all system, real-time, trigger, data capture, and playback parameters.

5. Press the soft key beneath "next" to select the system setup about which status information will be obtained.

6. Press the soft key beneath "EXIT" to return to the recorder's base display.

3-14 Setting a Manual Trigger



The Sequence of Steps

1 Press the [TRIGGER] key of the MENU group.

The LCD display immediately shows the trigger "change" menu.

2 Press the soft key beneath "change."

The LCD display immediately shows the "MAIN or" menu.

3 Press the soft key beneath "MAIN or."

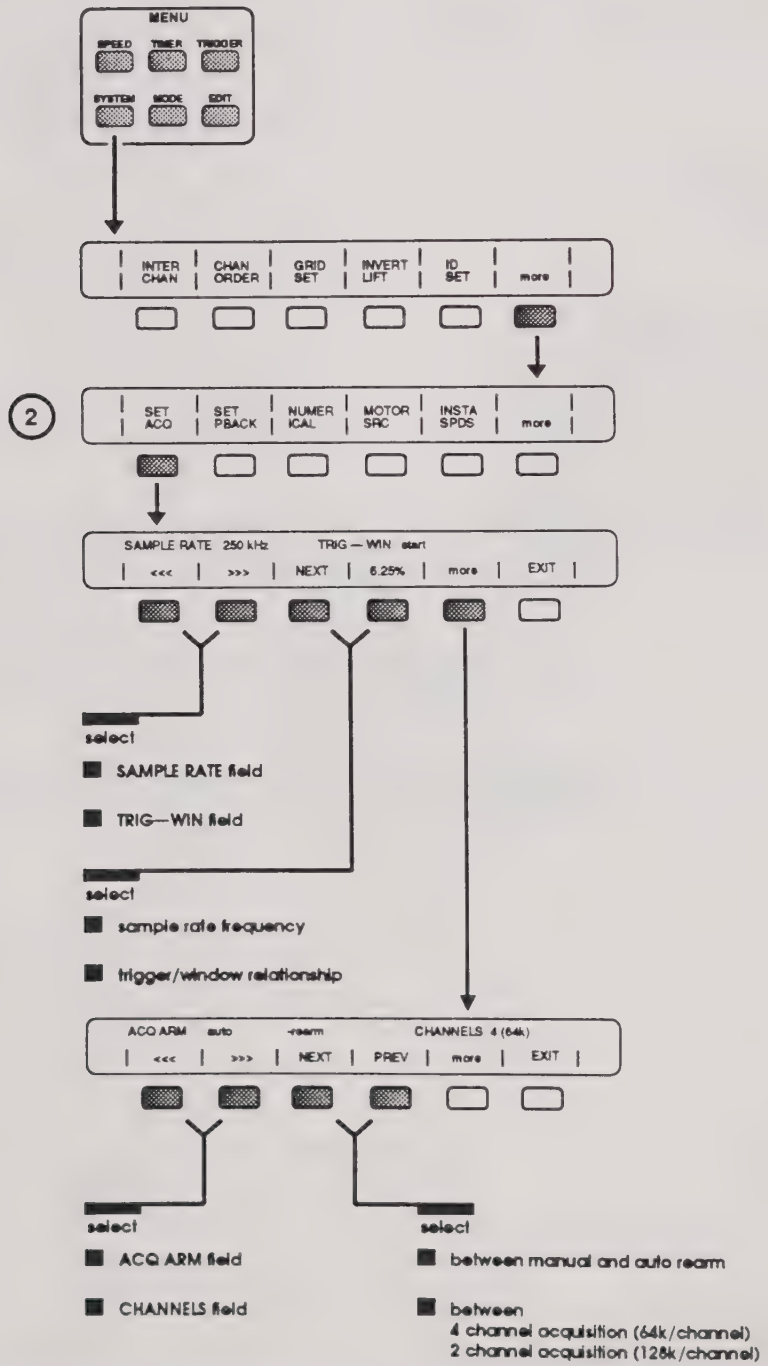
The LCD display immediately shows the "EXT/MAN/GPIB" menu.

4 Press the soft key beneath "MAN" and ensure that the manual trigger function is turned "on" as reflected in the menu.

The manual trigger function is now active and the DASH IV will recognize triggers initiated from the front-panel [TRIGGER] key of the Operation group.

5 Press the [TRIGGER] key of the Operation group to initiate a manual trigger.

3-15 Defining a Data Snapshot Window



The Sequence of Steps

defining the sample rate and the trigger/window relationship

1 Press the [SYSTEM] key of the MENU group.

2 Proceed to Level 2 of the [SYSTEM] key prime menu.

3 Press the soft key beneath "SET ACQ."

The LCD display immediately shows the "SAMPLE RATE / TRIG—WIN" menu.

This menu is used to specify:

- *the rate at which the DASH IV will sample data.*
- *the trigger/window relationship.*

4 Press the soft key beneath "<<<" or ">>>" to select either the sample rate parameter or the "TRIG—WIN" parameter.

5 Press the soft key beneath either "NEXT" or "PREV":

- when SAMPLE RATE is selected, scrolls either forward or backward through five available sample rates: 2, 10, 50, 125, 250.
- When TRIG—WIN is selected, scrolls either forward or backward through the available trigger/window relationship choices: $^{1}/_{16}$ through $^{15}/_{16}$ in $^{1}/_{16}$ increments.

The Sequence of Steps

defining acquisition arming preferences and allocating sample memory

1 Press the soft key beneath "more" in the "SAMPLE RATE / TRIG—WIN" menu.

The LCD display shows the "ACQ ARM / CHANNELS" menu.

This menu is used to specify either manual or automatic data capture readiness and to specify the number of kilosamples per channel to be stored in sample memory.

2 Press the soft key beneath "<<<" or ">>>" to select either the ACQ ARM parameter or the CHANNELS parameter.

3 Press the soft key beneath either "NEXT" or "PREV":

- when ACQ ARM is selected, causes the displayed ACQ ARM parameter to alternate between "manual" and "auto" rearm.

  When a trigger has been defined and the DASH IV is operating in the Data Capture mode,

  - if the ACQ ARM parameter is set for "auto," data will be automatically acquired when a trigger is sensed.

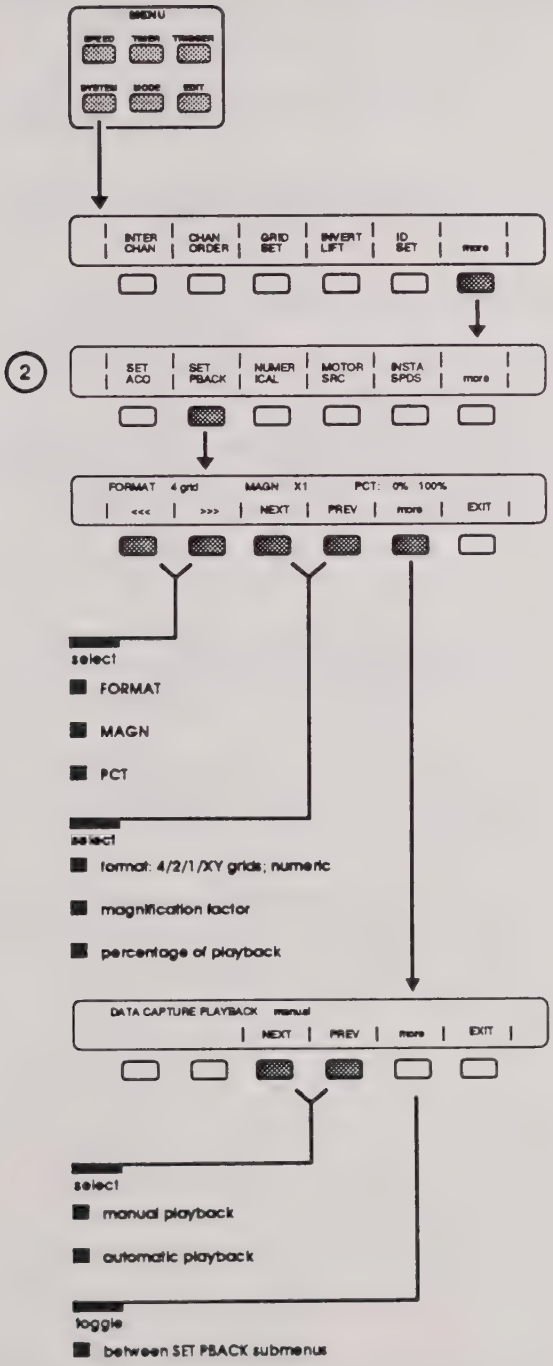
  - if the ACQ ARM parameter is set for "manual," data will be acquired only when:

    * the Data Capture (manual arm - manual playback option) menu structure is entered and

    * the soft key beneath "RUN" is pressed.

- when CHANNELS is selected, alternates between two allocation choices: 4 channels each with 64k of sample memory or 2 channels each with 128k of sample memory.

3-16 Defining a Data Snapshot Playback



The Sequence of Steps

defining a playback's format and magnification factor and specifying the percentage of captured data to be replayed

1. Press the [SYSTEM] key of the Menu group.

2. Proceed to Level 2 of the [SYSTEM] key prime menu.

3. Press the soft key beneath "SET PBACK."

   The LCD display shows the "FORMAT/MAGN/PCT" menu.

4. Press the soft key beneath "<<<" or ">>>" to individually select each of the three displayed parameters: PCT, MAGN, FORMAT.

5. Press the soft key beneath either "NEXT" or "PREV":

   - when FORMAT is the selected parameter, the display scrolls either forward or backward through five format options: 4 grid, 2 grid, 1 grid, XY plot, and numeric.
   - When MAGN is the selected parameter, the display scrolls either forward or backward through seven playback magnification factors: $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4, 8.
   - When PCT is the selected parameter, either increases or decreases the playback percentage in 1% increments from 0% to 100%.

The Sequence of Steps

defining whether a playback will be automatically initiated or manually initiated

1 Press the soft key beneath "more" in the "FORMAT/MAGN/PCT" menu.

The LCD display immediately shows the "DATA CAPTURE PLAYBACK" menu.

This menu is used to specify either manual or automatic playback of the data snapshot.

2 Press the soft key beneath either "NEXT" or "PREV" to alternate the display between "manual" and "automatic."

The choice that appears in the menu is the selected choice.

Section 4 Operation

4-1 General Information

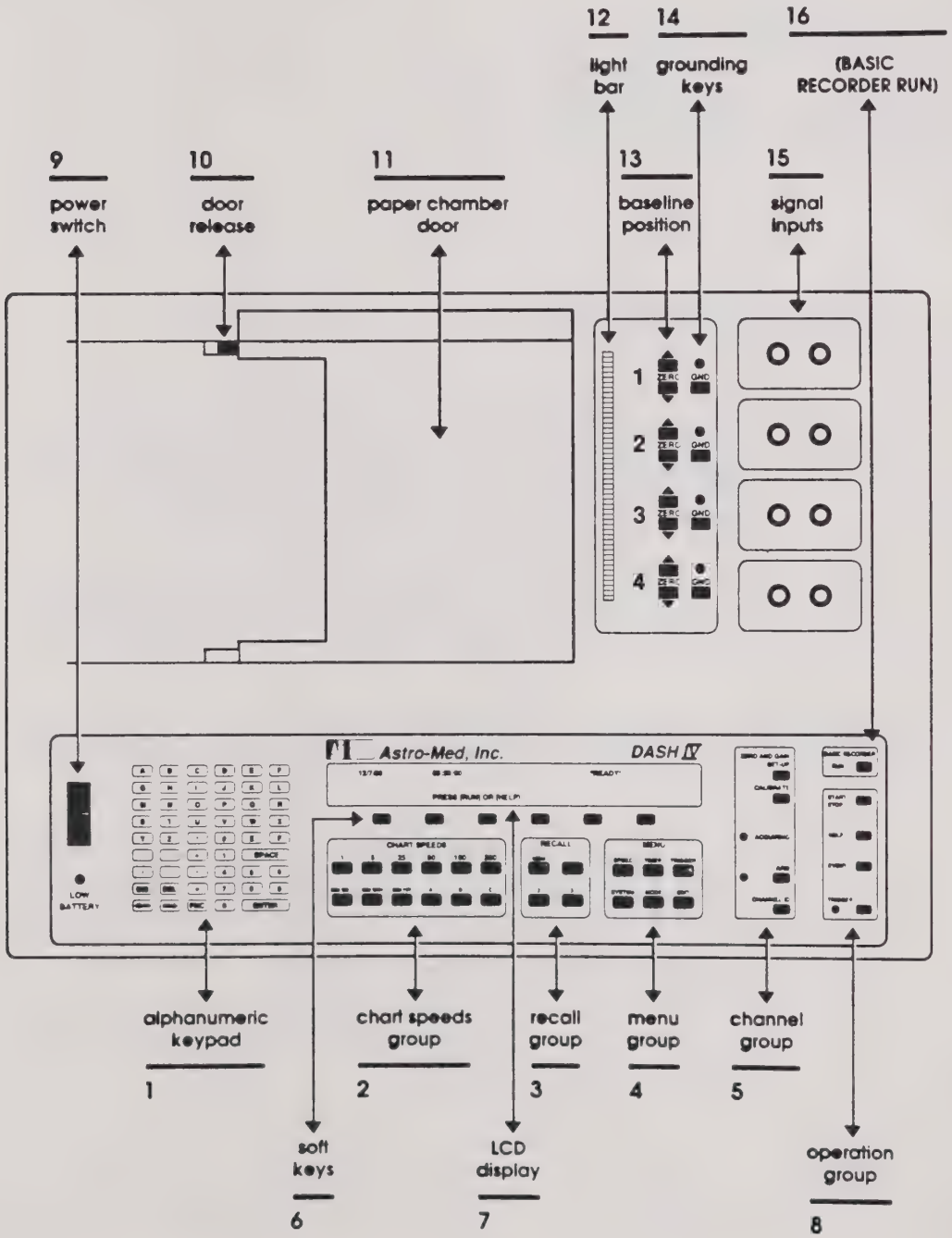
The basic DASH IV is a real-time recorder. All information regarding operation of the recorder's data capture and playback capabilities presupposes that the Data Capture and Playback option (DC-45) has been installed in the recorder.

Paragraphs 4-2 and 4-3 discuss the DASH IV's physical controls and features. The remaining paragraphs of this section provide specific information detailing all recorder operations.

4-2 Description of Front Panel Controls and Indicators

One of the first things to notice about the front panel of the versatile DASH IV is that control ***knobs*** have been completely eliminated. Instead, you control the recorder using convenient "one touch" pushbutton keys. Throughout this manual they will be referred to simply as "keys."

As shown on the following page, the chart recorder has sixteen distinct front panel features.


12
light bar
14
grounding keys
16
(BASIC RECORDER RUN)
9
power switch
10
door release
11
paper chamber door
13
baseline position
15
signal inputs
Astro-Med, Inc.
DASH IV
alphanumeric keypad
1
chart speeds group
2
recall group
3
menu group
4
channel group
5
soft keys
6
LCD display
7
operation group
8

1 Alphanumeric Keypad

As viewed from the recorder's front, the alphanumeric keypad is located on the left side of the front panel. It consists of six columns with nine keys in each column. The keypad contains keys representing the full alphabet, numeric keys 0 (zero) through 9, punctuation and symbol keys, insert and delete keys, left and right arrow keys, function key, and enter key.

2 CHART SPEEDS group

The keys of the top row of the CHART SPEEDS group represent six preprogrammed chart speeds.

The [MM/SEC], [MM/MIN], and [MM/HR] keys specify whether the selected chart speed will be in millimeters per second, per minute, or per hour.

The [A], [B], and [C] keys are "insta speed" keys that are programmable to the chart paper speeds of your choice.

3 RECALL group

The keys of the RECALL group are extremely powerful. Each of the numbered keys stores a complete system setup that is implemented when the [MEM] [1], [MEM] [2], or [MEM] [3] keying sequence is pressed.

"System setup" is a concise way of referring to all of the parameters that define any particular recording operation. Any given system setup can include up to approximately fifty recording parameters. You define as many or as few of these parameters as you need to record in the format you desire.

You no longer have to repeatedly reprogram the recorder to reestablish frequently used system setups. Now you can store them in their entirety and recall them with a key stroke.

4 MENU group

The keys of the MENU group include: [SPEED], [TIMER], [TRIGGER], [SYSTEM], [MODE], [EDIT].

These keys give you the flexibility to go directly to specific menus and quickly change the parameters in the menus. MENU keys are frequently used with the recorder's soft keys to define the recorder's operating conditions.

5 CHANNEL group

The keys of the Channel group enable you to define the signal conditioning parameters of the DASH IV's built-in signal conditioners, called Personality Modules. The individual keys of this group include [ZERO AND GAIN SETUP], [CALIBRATE], and [CHANNEL ID]. The ACQUIRING LED illuminates during data capture. The ARM LED illuminates when background data capture has been armed.

6 soft keys

Six keys are located immediately beneath the front panel display. Unlike the other controls of the front panel, these keys are not screened with labels identifying their purpose. They are "soft" in the sense that they have a variety of functions rather than a single, fixed purpose. Soft keys are always used when a mode or parameter is being viewed and defined on the recorder's front panel display.

The soft keys are physically below the front panel display because they are always used in correlation with the information shown in the display.

When a system parameter or recording mode is being implemented, it is often necessary to specify data and to chose from alternatives within the parameter or mode. The soft keys are used to select and define menu options.

7 LCD Display

The front panel display is a 5 7/8" by 1/2" liquid crystal diode (LCD) display located near the center and top of the front panel. The display has two 40-character lines. One line of information is displayed above the other. The display clearly presents both upper and lower case characters. The full 96-character ASCII set is supported by the display.

8 Operation group

The right side of the front panel contains a column of four unrelated "operation" keys: [START STOP], [HELP], [EVENT], and [TRIGGER]. An LED opposite the [TRIGGER] key illuminates when any trigger is sensed.

"Operation" here indicates simply that, when pressed, each key results in a specific and immediate recorder operation.

9 power switch

The recorder's electrical power ON / OFF—STANDBY rocker switch is located in the upper right-hand corner of front panel.

10 paper-chamber door release

The paper-chamber door release allows a pneumatic piston to open the paper chamber door and hold it open.

11 paper-chamber door

The paper-chamber door retains the thermal paper roll in the paper chamber.

12 light bar

A light bar is located to the right of the recorder's four zero-position controls. The light bar has 50 elements and is associated with the DASH IV's printhead. The light bar provides a visual reference indicating the real-time positions of all traces being printed.

13 zero baseline position keys

The [ZERO] keys are used to manually position each zero baseline within its channel.

14 grounding keys

The [GND] keys provide a method for manually grounding the individual signal that is being input into each of the recorder's channels.

15 Personality Module signal inputs

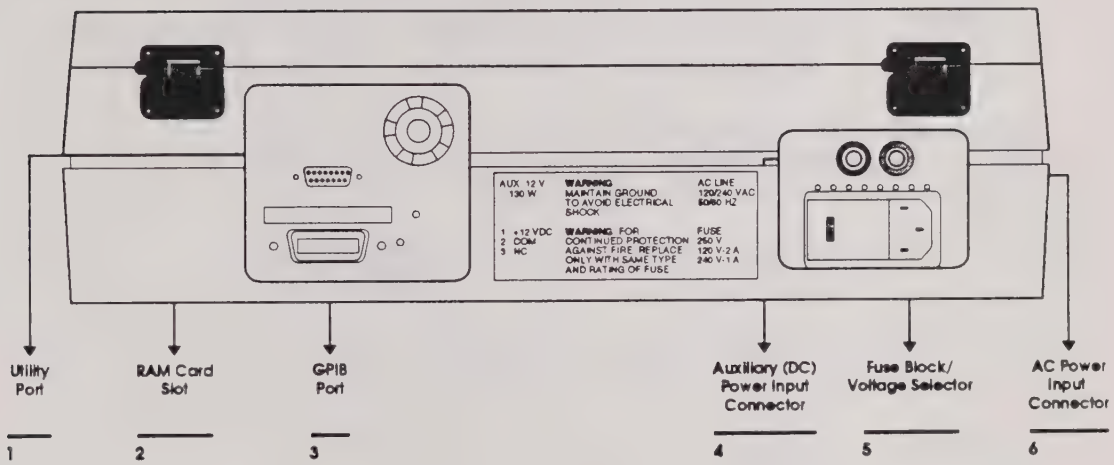
Each Personality Module has signal-input connections. These type of connection supplied depends on the type of Personality Module being used.

16 [BASIC RECORDER RUN] key

The [BASIC RECORDER RUN] key immediately enters the DASH IV into 4-channel real-time recording.

4-3 Rear Panel Input/Output Connections

The features of the rear panel of a DASH IV are illustrated below. A brief description of each feature is provided.



1 Utility port

The Utility D-shell connector is a multipurpose 15-pin D-shell connector used to communicate various externally generated commands to the recorder. For further information, see paragraph 2-4 of Section 2, "Wiring the 15-Pin D-shell Connector."

2 Random Access Memory (RAM) card slot

The RAM Card Slot accepts Astro-Med System Software Cards and Data Capture RAM Cards.

3 GPIB port

The GPIB D-shell connector is the IEEE communications interface between the DASH IV and various host-computer configurations. Control of the DASH IV by host computer is documented in the DASH IV Host Control Operations Manual.

Pin connections for the GPIB D-shell connector are provided in the table below.

Description	Pin #
DIO1	1
DIO2	2
DIO3	3
DIO4	4
EOI	5
DAV	6
NAFD	7
NDAC	8
IFC	9
SRQ	10
ATN	11
SHIELD	12
DIO5	13
DIO6	14
DIO7	15
DIO8	16
REN	17
GROUND (6)	18
GROUND (7)	19
GROUND (8)	20
GROUND (9)	21
GROUND (10)	22
GROUND (11)	23
GROUND LOGIC	24

GROUND (X) = the signal ground return of the referenced contact.

4 Auxiliary (DC) Power Input Connectors

These connectors allow the recorder to be powered with externally supplied 12-volt direct current.

5 fuse block and voltage selection cylinder

The fuse block and voltage selection program cylinder are both located beneath the power input receptacle. See Section 6 of this manual for fuse changing and voltage changing procedures.

CAUTION

Avoid over-voltage damage. When powering the DASH IV externally, do not exceed the specified voltage requirement of 11 - 16 VDC.

6 AC Power Input Connector

The power input receptacle is a male connector consisting of three protruding contacts. The female end of the DASH IV's power cord is pushed onto these contacts and seated. The male end of the power cord is then inserted into an electrical outlet to supply power to the recorder. The power input receptacle is located in the lower left corner of the rear panel. It is labelled "AC LINE."

Power Requirements

line:	fuse:
115/230 VAC 50/60 Hz	115 volts, 2 amperes (250 V) 230 volts, 1 ampere (250 V)

4-4 Use of Front Panel Controls

Use of the front panel controls is discussed in the following order: alphanumeric keypad, CHART SPEEDS group, RECALL group, MENU group, Channel group, [BASIC RECORDER RUN] key, and Operation group.

As you use the controls of the front panel, remember that, when a setting is shown on the front panel display, that setting takes immediate effect.

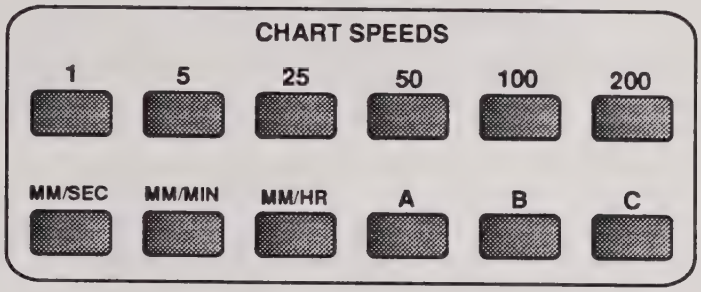
You must confirm your choice by pressing the [ENTER] key of the alphanumeric keypad *only* when:

- defining the [SPEED] key of the MENU group
- changing the order of the recorder's channels.

Alphanumeric Keypad

The alphanumeric keypad is used to enter and delete information in the recorder's interchannel buffers. When the recorder's [EDIT] key has been invoked, the alphanumeric keypad can be used to enter and delete information. The keypad is also occasionally used to change certain recording parameters.

CHART SPEEDS Group



You can instantly change recording speed by using the keys of the CHART SPEEDS group.

The keys of the top row of the CHART SPEEDS group are labelled 1, 5, 25, 50, 100, and 200 indicating six instantly selectable speeds.

The [MM/SEC], [MM/MIN], and [MM/HR] keys of the bottom row are used to select the speed range: millimeters per second, minute, or hour.

The [A], [B], and [C] keys of the bottom row are individually programmable "insta-speed" keys. Use them to program speeds that may be frequently used but are not available through the fixed speeds of the CHART SPEEDS group.

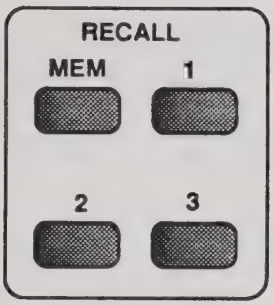
To program the [A], [B], and [C] keys, refer to the discussion of the INSTA SPDS setup on page 4-53 of this manual.

When you are recording in any real-time mode and you press any speed or insta speed key from the CHART SPEEDS group, that speed is immediately implemented. The previous speed is lost.

The recording speed remains as selected until:

- another key of the CHART SPEEDS group is pressed; or
- the real-time recording mode menu that has been changed is accessed and its speed (SPD) parameter is redefined.

RECALL Group



MEM invokes menu to save system setups

1, 2, and 3 either save or replace current system setups

The keys of the RECALL group allow you to store and recall three complete system setups. Consequently, the RECALL group is a particularly useful feature if your requirements demand the frequent use of a number of differently configured system setups.

Recall Group:
To program a complete system setup into a RECALL key

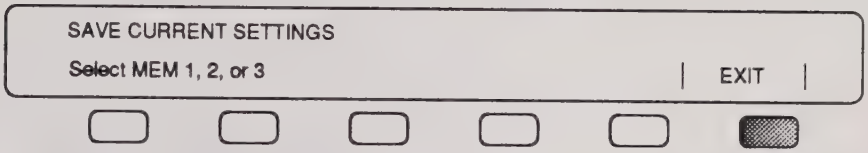
1 Press the [SYSTEM] key of the MENU group.

2 Use the [SYSTEM] key menu and to set each recording parameter.

As you change each recording parameter, remember that any ongoing recording is immediately changed to reflect the newly defined setting.

3 Press the [MEM] key of the RECALL group.

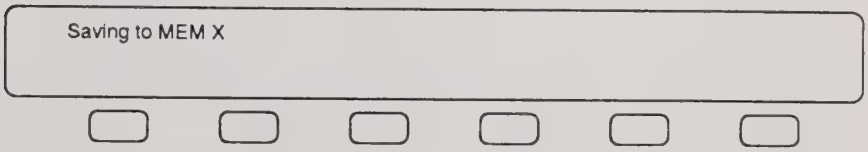
When the [MEM] key is pressed, the following menu option results:



This indicates that all of the setup parameters defining the current system will be saved into the RECALL group's individual [1], [2], or [3] key when the key is pressed.

4 Press the RECALL group numeric key into which you want to store the system you just defined.

When the desired storage key is pressed, the front panel display reads:



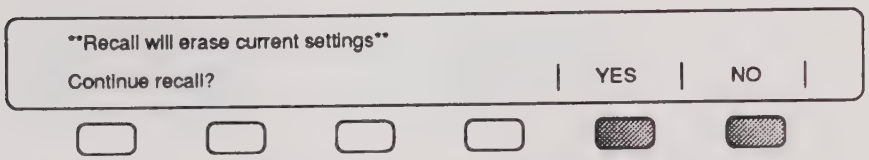
where X is the selected key number

Recall Group:
To retrieve a system setup using a RECALL key

1

Press the RECALL group numeric key containing the system setup that you want to invoke: either [1], [2], or [3].

This results in the following display.

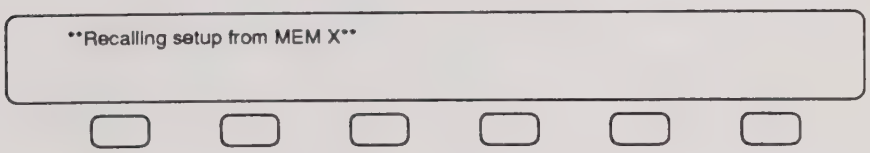


This message indicates that all ongoing recording parameters will be replaced with those of the recalled setup when the RECALL setup key is pressed.

2

Press the soft key under the front panel display that corresponds to either the "YES" or "NO" choice.

- Pressing "NO" returns the recorder to its base display.
- Pressing "YES" results in the following display:

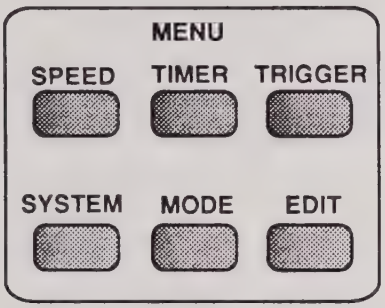


where X is the selected key number

Recall Group:
To get a list of system parameters stored in RECALL keys

Press the recorder's [HELP] key to access the menus used get a list of any of the system setups programmed into the RECALL keys.

MENU Group



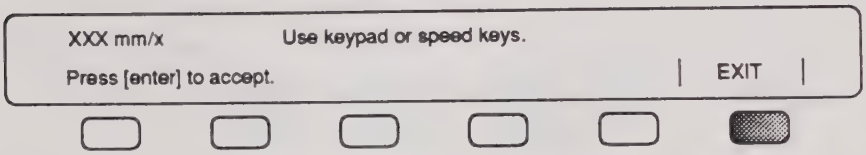
MENU group invokes recorder's primary operational menus

The MENU group consists of six keys labeled [SPEED], [TIMER], [TRIGGER], [SYSTEM], [MODE], [EDIT]. The use of each key is explained below.

(SPEED) Key

The [SPEED] key provides direct access to the speed menu. This allows you to specify any valid chart speed that might not be immediately available through the keys of the CHART SPEEDS group.

Pressing the [SPEED] key results in the following front-panel display:



where: XXX is the speed that you specify.
mm/x is millimeters per second, minute, or hour per your choice.

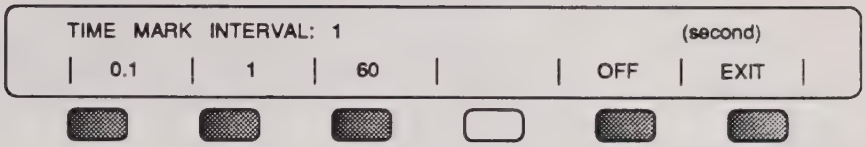
Use the alphanumeric keypad to enter the speed you want to implement. (You can also use any of CHART SPEEDS keys to directly enter a preset speed.)

Press the [ENTER] key to have the chart recorder accept the speed. When you press [ENTER], the recorder accepts the speed and returns to the front-panel base display.

Pressing "EXIT" before the speed has been entered aborts the chart speed change and returns the recorder to the base front-panel display.

(TIMER) Key

Pressing the [TIMER] key causes the timing mark menu to be shown on the front-panel display.



Choosing any of the timing mark options causes the recorder to print timing marks along the left edge of the chart paper at the time interval selected. Timing marks appear as small "tick marks."

0.1, 1, 60 Pressing the soft key beneath the desired timing mark interval initiates printing of the timing mark at the specified interval.

OFF "OFF" causes the recorder to stop printing timing marks.

EXIT "EXIT" returns the recorder to the front-panel base display.

The DASH IV can be programmed to either:

- capture data when a trigger is sensed, or
- enter dual-speed operation when a trigger is sensed.

The [TRIGGER] key accesses the menus used (1) to set each channel's slope-and-level triggering criteria and (2) to set the trigger source.

In the DASH IV, several trigger sources can be active at the same time. These trigger sources are identified in the trigger menus as:

WAVE the individual channel's input waveform signal when the slope-and-level triggering critirea that you program are met. There are four channels and each is an individual trigger source.

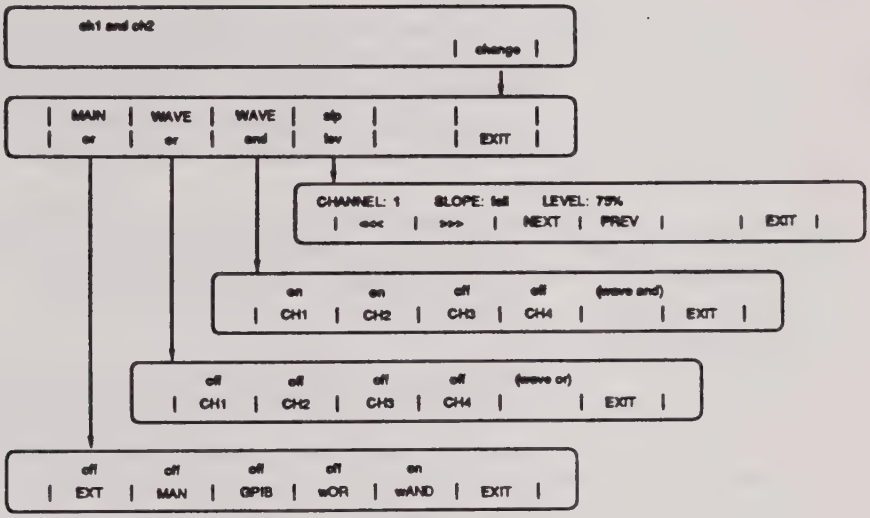
EXT an externally applied TTL-Low or switch closure

MAN the recorder's front-panel manual [TRIGGER] key

GPIB host-computer command

The overall flow of trigger menu displays is shown in the figure on the opposite page. Each trigger menu is individually explained in "The Trigger Submenus."

Before proceeding to the menu explanations, however, a brief overview of trigger guidelines is presented.



Guidelines for Specifying Trigger Sources

- If you want to select either EXT, MAN, or GPIB as the single trigger source, simply go to the "EXT/MAN/GPIB" submenu and turn the desired selection "on."

- If you want to select any individual channel as the single trigger source, first go to the "EXT/MAN/GPIB" submenu and turn [wOR] "on." Next, go to the "WAVE or" submenu and turn the desired channel "on".

  You can use the "WAVE and" submenu in exactly the same way to select an individual channel as the sole trigger.

- If you want to create an "AND" trigger combination, first go to the "EXT/MAN/GPIB" submenu and turn [wAND] "on." Next, go to the "WAVE and" submenu and turn "on" all the channels you want joined in an "AND" condition.

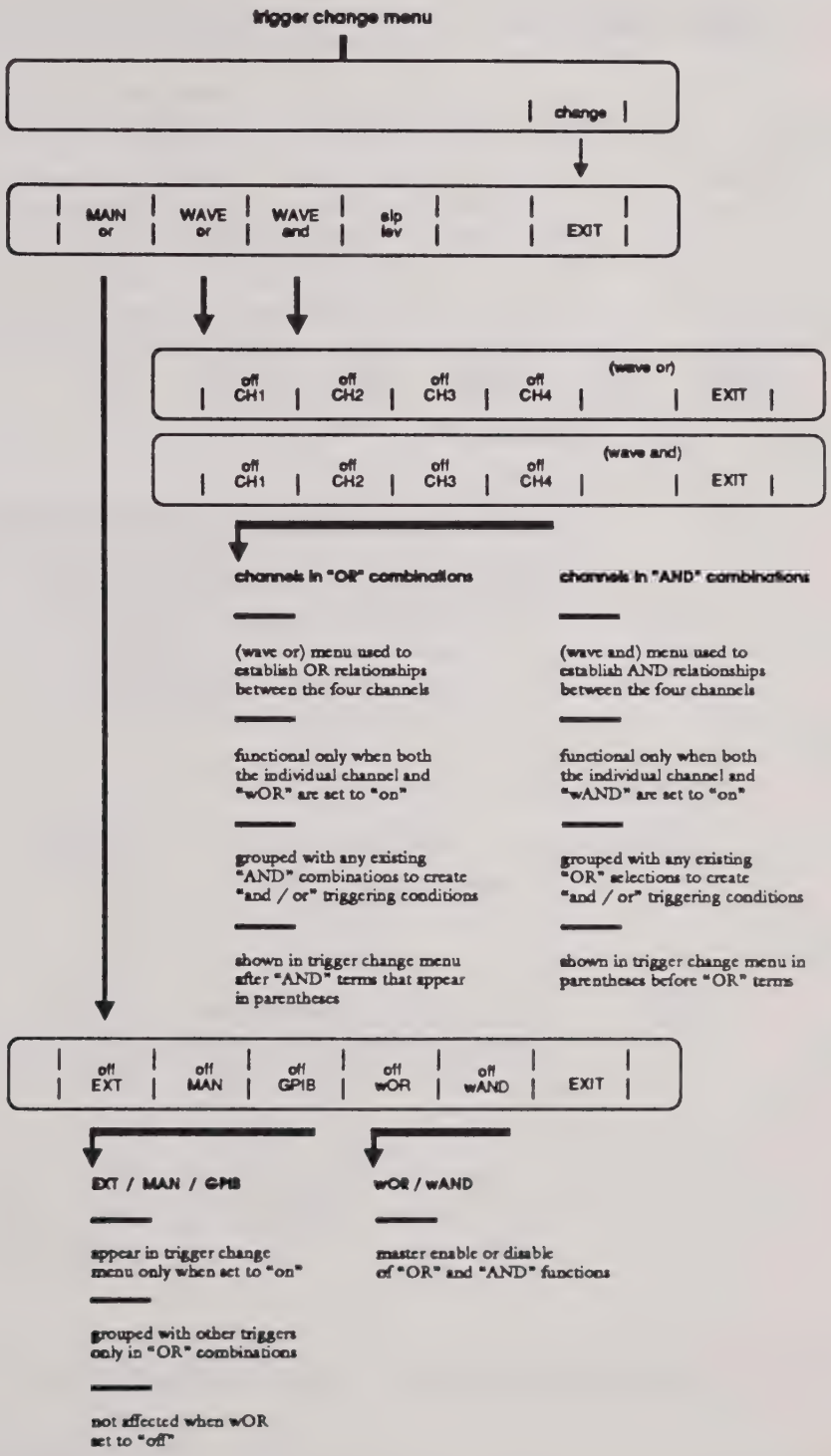
  Note that you can only setup an "AND" between the channels themselves. Any other active trigger sources are automatically "OR'ed" to the "AND" combinations you create.

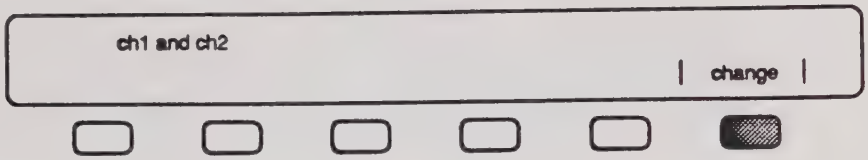
- If you want to create an "OR" trigger combination, first go to the "EXT/MAN/GPIB" submenu and turn [wOR] "on." Next, go to the "WAVE or" submenu and turn "on" all the channels you want joined in an "OR" condititon.

  Any other active trigger sources are automatically "OR'ed" to the "OR" combinations you create.

- AND/OR trigger combinations are automatically created and shown in the trigger change menu whenever AND combinations and OR combinations have both been enabled in the trigger-source selection process.

These guidelines are visually summarized on the following page.


trigger change menu
change
MAIN or
WAVE or
WAVE and
slp lev
EXIT
off CH1
off CH2
off CH3
off CH4
(wave or)
EXIT
(wave and)
channels in "OR" combinations
(wave or) menu used to establish OR relationships between the four channels
functional only when both the individual channel and "wOR" are set to "on"
grouped with any existing "AND" combinations to create "and / or" triggering conditions
shown in trigger change menu after "AND" terms that appear in parentheses
channels in "AND" combinations
(wave and) menu used to establish AND relationships between the four channels
functional only when both the individual channel and "wAND" are set to "on"
grouped with any existing "OR" selections to create "and / or" triggering conditions
shown in trigger change menu in parentheses before "OR" terms
off EXT
off MAN
off GPIB
off wOR
off wAND
EXIT
EXT / MAN / GPIB
appear in trigger change menu only when set to "on"
grouped with other triggers only in "OR" combinations
not affected when wOR set to "off"
wOR / wAND
master enable or disable of "OR" and "AND" functions

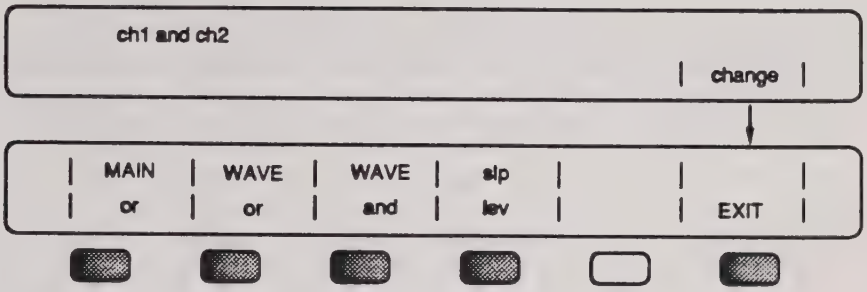


When the [TRIGGER] key is pressed, a display is generated that shows the currently defined "AND / OR" trigger sources.

NOTE

Menu choices are selected by pressing the soft key beneath the choice. In this and all discussions of the use of the front panel soft keys, it is understood that the phrase "Pressing the soft key beneath" the menu choice is a part of all the instructions provided.

change "change" invokes the "MAIN or" submenu.



MAIN or "MAIN or" invokes the menu that

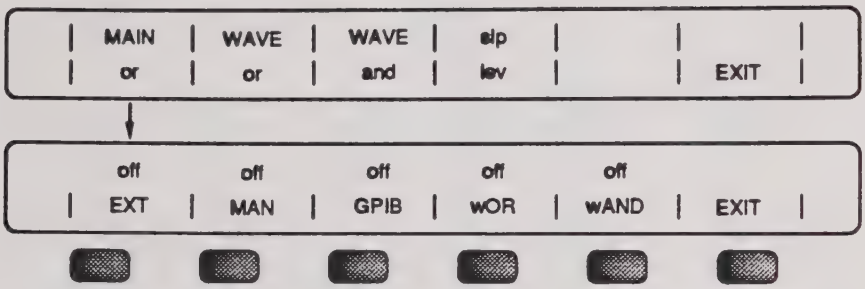
- enables or suppresses the external, manual, GPIB, and waveform signal trigger sources
- comprehensively enables or suppresses all "AND" and "OR" trigger combinations

WAVE or "WAVE or" invokes the menu that enables or suppresses OR relationships between the four channels.

WAVE and "WAVE and" invokes the menu that enables or suppresses AND relationships between the four channels.

slp lev "slp lev" invokes the menu used to individually define for each channel the signal slope-and-level that will be recognized as a trigger.

EXIT "EXIT" returns the recorder to the trigger change menu.



The EXT / MAN / GPIB submenu is used to enable or disable triggers generated externally, manually, or through host-computer command. The menu also enables or suppresses overall OR and AND functions.

EXT "EXT" causes this menu selection to read either "on" or "off." Recognition of external triggers is enabled when EXT is set to "on" and disabled when set to "off."

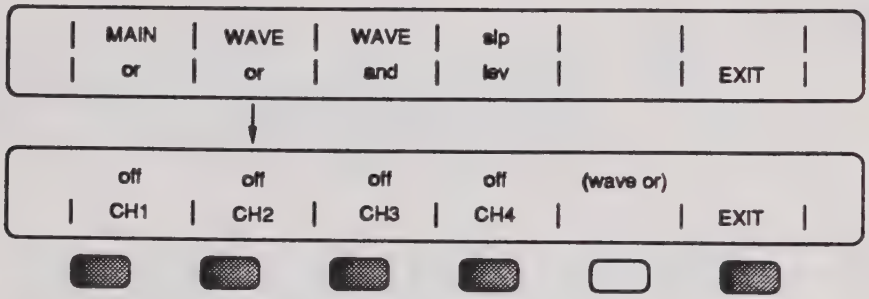
MAN "MAN" causes this menu selection to read either "on" or "off." Recognition of triggers generated from the front-panel [MANUAL TRIGGER] key is enabled when MAN is set to "on" and disabled when set to "off."

GPIB "GPIB" causes this menu selection to read either "on" or "off." Recognition of triggers generated by host-computer command is enabled when GPIB is set to "on" and disabled when set to "off."

wOR "wOR" causes this menu selection to read either "on" or "off." Recognition of OR trigger-combinations is enabled when wOR is set to "on" and disabled when set to "off." No OR trigger-combinations will be recognized unless this function is turned "on."

wAND "wAND" causes this menu selection to read either "on" or "off." Recognition of AND trigger-combinations between the four channels is enabled when wAND is set to "on" and disabled when set to "off." No AND trigger-combinations will be recognized unless this function is turned "on."

EXIT "EXIT" returns the recorder to the "MAIN or" menu.



Pressing the soft key beneath "WAVE or" invokes the menu used to establish OR trigger-source combinations between the four channels.

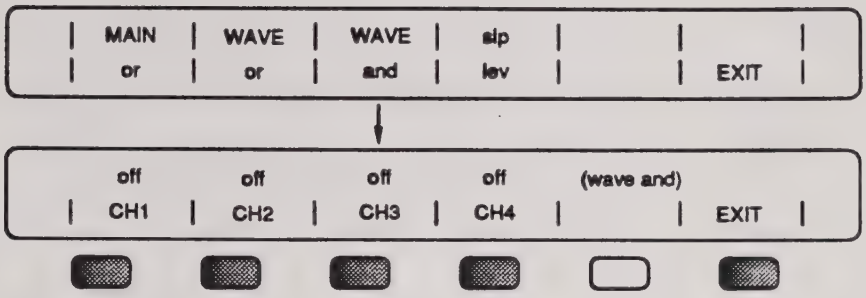
You can also use this menu to select a single channel as a trigger source by:

- ensuring that no other trigger selections are active.
- ensuring that [wOR] in the EXT / MAN / GPIB submenu is set to "on."
- turning "on" a single channel in the "WAVE or" submenu.

CH1,CH2, CH3, CH4 Any of the channel choices causes that channel to read either "on" or "off". This enables or suppresses the selected channel as part of an OR trigger-source combination. When a turned "on." the selected channel is is automatically "OR'ed" to any other trigger source selections.

No OR combinations will be recognized unless [wOR] in the "EXT / MAN / GPIB" submenu is set to "on."

EXIT "EXIT" returns the recorder to the trigger change menu.



Pressing the soft key beneath "WAVE and" invokes the menu used to establish AND trigger-source combinations between the four channels.

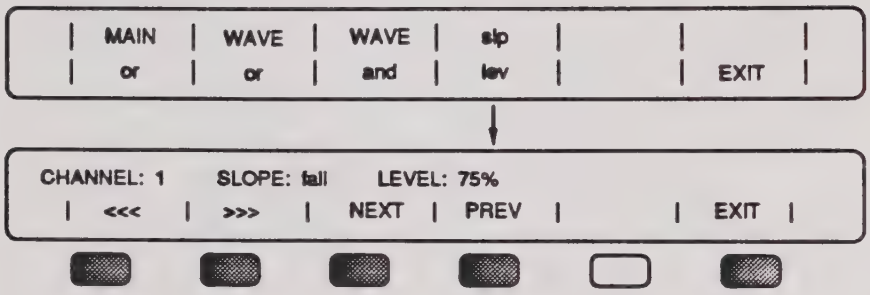
You can also use this menu to select a single channel as a trigger source by:

- ensuring that no other trigger selections are active.
- ensuring that [wAND] in the "EXT / MAN / GPIB" submenu is set to "on."
- turning "on" a single channel in the "WAVE and" submenu.

CH1,CH2, CH3, CH4 Any of the channel choices enables or suppresses that channel as part of an AND trigger-source combination. A channel is selected as a part of an AND trigger-source combination when the channel is to "on."

No AND combinations will be recognized unless [wAND] in the "EXT / MAN / GPIB" submenu is set to "on."

EXIT "EXIT" returns the recorder to the trigger change menu.



The "slp lev" submenu allows you to define the SLOPE on which the trigger will be detected and the percentage of the full scale voltage LEVEL that will constitute a trigger.

<<< or >>> "<<<" or ">>>" alternately selects either the CHANNEL, SLOPE, or LEVEL parameter for change.

NEXT or PREV "NEXT" or "PREV" scrolls through the choices available within the selected CHANNEL, SLOPE or LEVEL parameter.

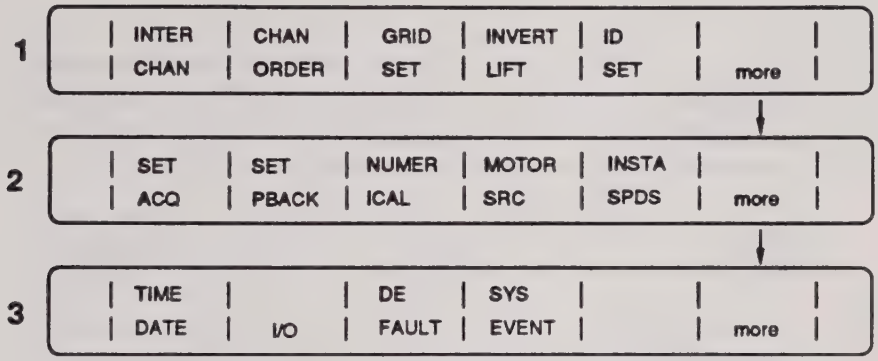
If CHANNEL is the selected parameter, the "NEXT" or "PREV" options scroll through the following choices: 1, 2, 3, 4.

If SLOPE is the selected parameter, the "NEXT" or "PREV" options scroll through the following choices: rise, fall, both.

If LEVEL is the selected parameter, the "NEXT" or "PREV" options scroll through trigger levels of 0% through 100% in 1% increments.

EXIT "EXIT" returns the recorder to the trigger change menu.

(SYSTEM) Key



Pressing the [SYSTEM] key invokes the first of three successive displays that comprise the [SYSTEM] key prime menu. For clarity, each display will be considered a level of the prime menu and will be discussed as Level 1, Level 2, etc. The [SYSTEM] key prime menu provides access to the menus that define the DASH IV's fourteen principal setup categories.

Each selection of the [SYSTEM] key prime menu has its own set of submenus. Each submenu is used to define one or more of the system setup parameters. Each setup parameter has its own effect the appearance and content of the printed chart. Together, the parameters defined under the [SYSTEM] key make up a total system setup. Because system setups are numerous, it is convenient to organize them into four groups of logically related data: SYSTEM PARAMETERS, REAL-TIME PARAMETERS, TRIGGER CHANNEL SETTINGS, and DATA CAPTURE / PLAYBACK.

The tables that follow comprehensively list each of the DASH IV's setup parameters and provide the default values for each parameter.

Table 4-1.
DASH IV General System Parameter Defaults

System Parameter	Channel 1	Channel 2	Channel 3	Channel 4
pen	down	down	down	down
signal	normal	normal	normal	normal
interchannel buffers	annotation	annotation	annotation	annotation
range	500vfs	500vfs	500vfs	500vfs
coupling	normal	normal	normal	normal
zero suppression	0	0	0	0
signal conditioner mode	pk – pk	pk – pk	pk – pk	pk – pk
filter	off	off	off	off
numeric settings	=0000 to +1000 EE-1	=0000 to +1000 EE-1	=0000 to +1000 EE-1	=0000 to +1000 EE-1
channel order	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4

Table 4-1.
DASH IV General System Parameter Defaults (continued)

Parameter	Setting
channel order	1,2,3,4
grid	on
grid minor divisions	on
auto id	off
system event #1	off
system event #2	off
system event #3	off
system event #4	off
time marks	off
motor source clock	internal

Table 4-2.
DASH IV Real-Time System Parameter Defaults

Parameter	Setting	
current speed	025 mm/s	
insta speed A	010 mm/s	
insta speed B	075 mm/s	
insta speed C	150 mm/s	
timer mode	4 grid	
timer speed	025 mm/s	
start time and date	01/01/90	00:00:00
stop time and date	01/01/90	00:00:00
dual speed mode	4 grid	
speed 1	025 mm/s	
speed 1 duration	00:00:05	
speed 2	050 mm/s	
speed 2 duration	00:00:05	
datalogger speed	175 ms/l	

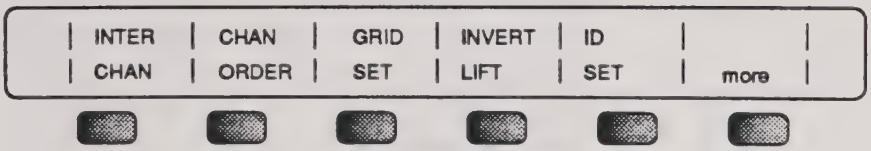
Table 4-3.
DASH IV Data Capture / Playback Parameter Defaults

Parameter	Setting
sample rate	250 kHz
trigger/ window relationship	start
number of channels	4
acquisition rearm	manual
playback mode	4 grid
magnification	x1
playback percentages	0% – 100%
X channel	1
Y channel	2
playback rearm	manual

Table 4-4.
DASH IV Trigger Setting Defaults

Channel Number	Slope	Level
1	rise	00%
2	rise	00%
3	rise	00%
4	rise	00%

(SYSTEM) Key Prime Menu: Level 1



When the [SYSTEM] key is pressed, Level 1 of the prime menu is displayed. Level 1 of the [SYSTEM] key prime menu allows you access menus that define the recording setups listed below.

NOTE

Menu choices are selected by pressing the soft key beneath the choice. In this and all discussions of the use of the front panel soft keys, it is understood that the phrase "Pressing the soft key beneath" the menu choice is a part of all the instructions provided.

INTER CHAN "INTER CHAN" invokes menus used to print or suppress interchannel annotation or event markers (EM-44 required).

CHAN ORDER "CHAN ORDER" invokes menus used to define the order in which channels are printed from right to left across the chart as viewed from the front of the recorder.

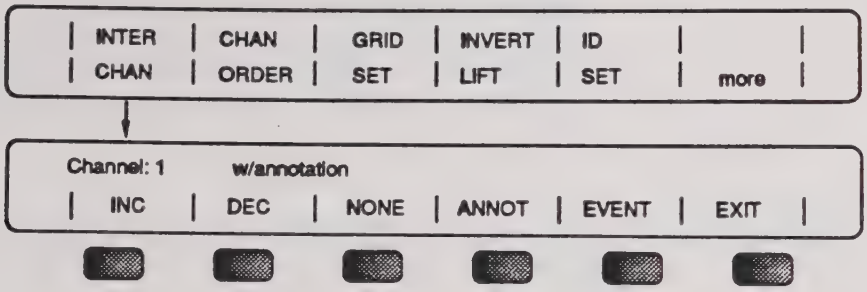
GRID SET "GRID SET" invokes menus used to either enable or suppress grid printing. Enables or suppresses printing of minor divisions.

INVERT/LIFT "INVERT/LIFT" invokes menus (1) used to print the signal with either normal or inversed polarity and (2) used to determine whether an individual channel will be printed or not printed.

ID SET "ID SET" either enables or suppresses automatic and continuous printing of channel identification numbers in the first portion of every print buffer each time the buffer is printed.

more "more" invokes Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 1—
INTER CHAN setup



Pressing the soft key beneath the "INTER CHAN" display invokes the menu that selects or suppresses the printing of alphanumeric annotation in the recorder's interchannel buffers.

INC "INC" selects the next higher channel.

DEC "DEC" selects the next lower channel.

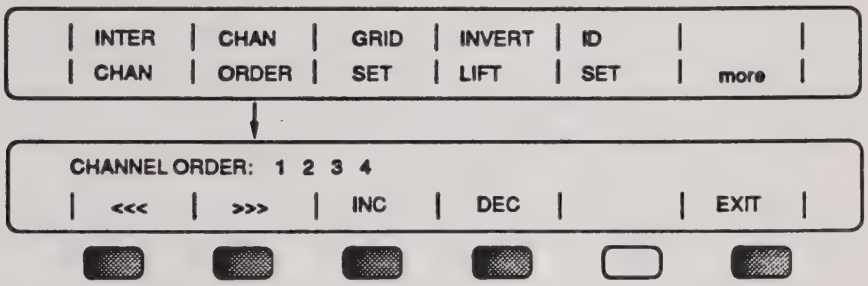
NONE "NONE" suppresses printing of interchannel annotation.

ANNOT "ANNOT" enaables printing of interchannel annotation.

EVENT "EVENT" selects interchannel event markers for display in the indicated interchannel buffer.

EXIT "EXIT" returns the recorder to the Level 1 display of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 1— CHAN ORDER setup



Pressing the soft key beneath the "CHAN ORDER" display invokes the menu that defines the order in which channels are printed from left to right across the chart paper.

<<< or >>> "<<<" or ">>>" moves through the channels shown in the display in the direction of the chosen arrowheads: either left or right. When a channel is selected, it blinks regularly indicating that it can be changed.

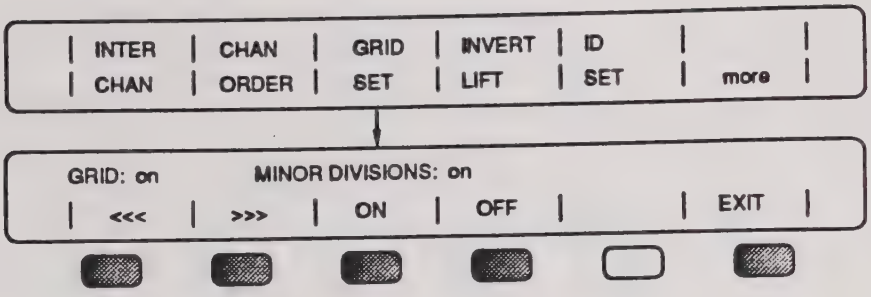
INC "INC" increases the selected channel to the next higher channel number.

DEC "DEC" decreases the selected channel to the next lower channel number.

EXIT "EXIT" returns the recorder to the Level 1 display of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 1—

GRID SET setup



Pressing the soft key beneath "GRID SET" invokes the menu that enables or suppresses grid printing on the recorded chart. If grid printing is on, the GRID SET menu is used to enable or suppress the printing of minor grid divisions on the chart.

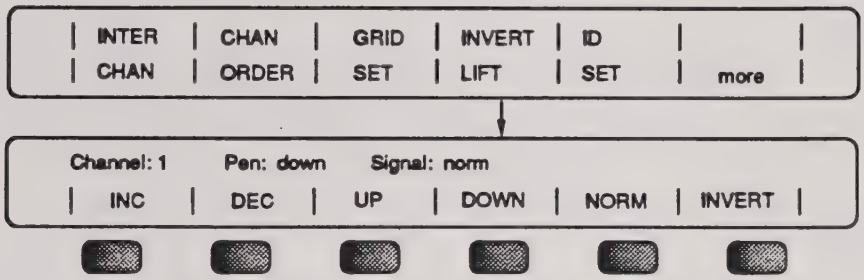
<<< or >>> "<<<" or ">>>" selects either the MINOR DIVISIONS parameter or the GRID parameter in the direction of the chosen arrowheads: either left or right. When a parameter is selected, it blinks regularly indicating that it can be changed.

ON or OFF "ON" either (1) enables the printing of a grid or (2) enables the printing of minor divisions in the selected grid.

"OFF" either (1) suppresses the printing of a grid or (2) suppresses the printing of minor divisions in the selected grid.

EXIT "EXIT" returns the recorder to the Level 1 display of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 1—
INVERT LIFT setup



Pressing the soft key beneath "INVERT LIFT" invokes the menu that enables or disables the printing of individual channels. The menu also determines whether a signal is printed with normal polarity or reversed polarity.

INC "INC" increases the selected channel to the next higher channel number.

DEC "DEC" decreases the selected channel to the next lower channel number.

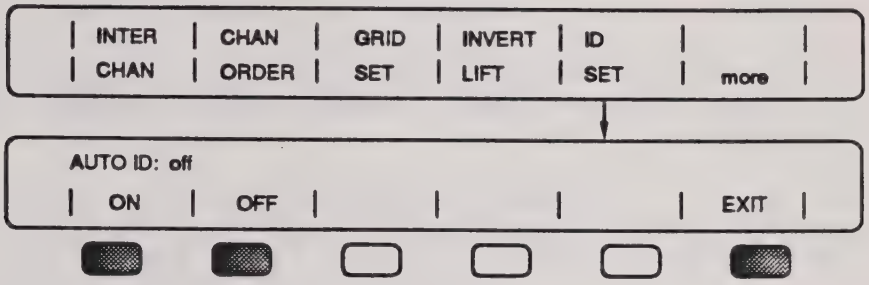
UP "UP" causes the Pen selection parameter to read "up." This results in suppression of printing in the selected channel. This is analogous to the old technology "pen up" condition. The UP selection applies only to the Pen parameter.

DOWN "DOWN" causes the Pen selection parameter to read "down." This results in printing in the selected channel. This is analogous to the old technology "pen down" condition. The "DOWN" selection applies only to the Pen parameter.

NORM "NORM" causes Signal parameter to read "norm." This indicates that the waveform will be recorded with normal signal polarity. The "NORM" selection applies only to the Signal parameter.

INVERT "INVERT" causes the Signal parameter to read "inv." This indicates that the waveform will be recorded with inverted signal polarity. The "INVERT" selection applies only to the Signal parameter.

(SYSTEM) Key Prime Menu: Level 1—
ID SET setup



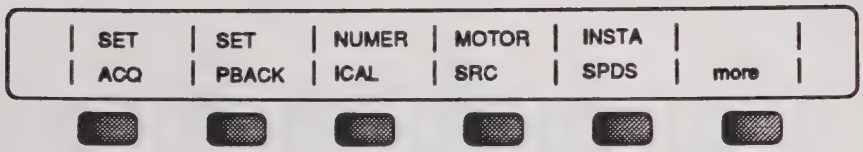
Pressing the soft key beneath "ID SET" invokes the menu that enables or suppresses automatic and continuous printing of channel identification numbers at the start of every print buffer.

ON "ON" enables automatic and continuous printing of channel identification numbers at the start of every print buffer.

OFF "OFF" suppresses automatic and continuous printing of channel identification numbers at the start of every print buffer.

EXIT "EXIT" returns the recorder to Level 1 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2



When the soft key beneath "more" in Level 1 of the [SYSTEM] key prime menu is pressed, Level 2 of the prime menu is displayed.

Level 2 of the [SYSTEM] key prime menu allows you access to menus that define the recording setups defined below.

SET ACQ "SET ACQ" invokes menus that define data capture acquisition parameters.

SET PBACK "SET BPACK" invokes menus that define parameters relevant to the playback of captured data.

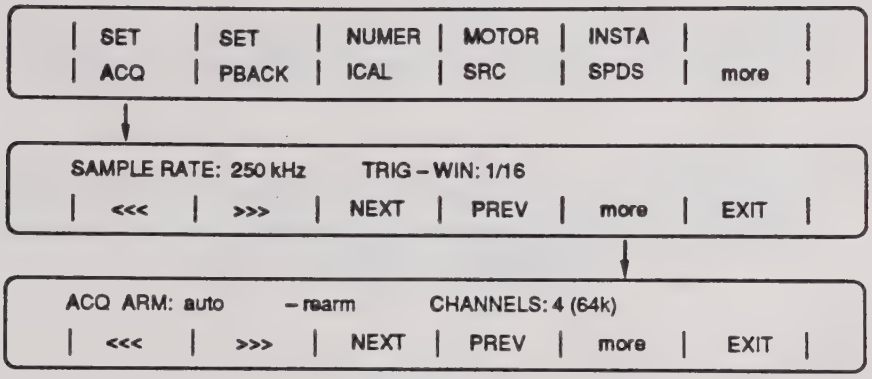
NUMERICAL "NUMERICAL" invokes the menu used to specify for each channel the conversion factors for the left and right edges of the waveform when recording in Datalogger mode. These factors are then used to scale waveform data for subsequent printing as tabular numeric data.

MOTOR SRC "MOTOR SRC" results in a menu that specifies whether motor clock speed control will be internal or external.

INSTA SPDS "INSTA SPDS" results in a menu used to define the instantly available speed values for the [A], [B], and [C] insta-speed keys of the CHART SPEEDS group.

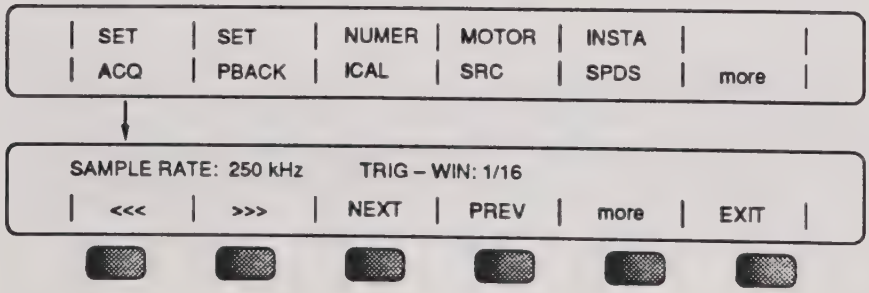
more "more" invokes the Level 3 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2— SET ACQ submenu sequence



Pressing the soft key beneath "SET ACQ" invokes the first of two submenus that define data acquisition parameters.

(SYSTEM) Key Prime Menu: Level 2— SET ACQ submenu 1



Submenu 1 is used to specify (1) the rate at which the DASH IV will sample data and (2) the trigger/window relationship.

<<< or >>> "<<<" or ">>>" selects either the SAMPLE RATE parameter or the TRIG—WIN parameter for definition. "<<<" selects form the left. ">>>" selects from the right. When a parameter is selected, it blinks regularly indicating it can be changed.

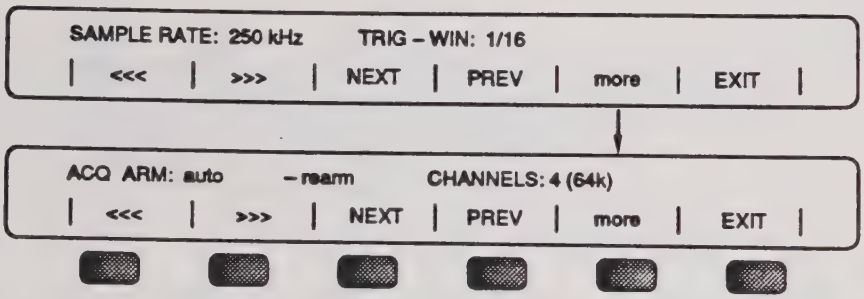
NEXT or PREV Pressing the soft key beneath either "NEXT" or "PREV":

- when SAMPLE RATE is selected , scrolls either forward or backward through five available sample rates: 2, 10, 50, 125, 250.
- when TRIG—WIN is selected, scrolls either forward or backward through the available trigger/window relationship choices: $^{1}/_{16}$ through $^{15}/_{16}$ in $^{1}/_{16}$ increments. The alphanumeric keypad is used to specify the desired numeric percentage.

more "more" selects SET ACQ submenu 2.

EXIT "EXIT" returns the display to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2—
SET ACQ submenu 2



Submenu 2 is used to specify either manual or automatic data capture readiness and to specify the number of kilosamples to be stored in sample memory. When a trigger has been defined and the DASH IV is operating in the Data Capture mode,

- if the ACQ ARM parameter is set for "auto," data will be automatically acquired when a trigger is sensed.
- if the ACQ ARM parameter is set for "manual," data will be acquired only when:
  - the Data Capture menu structure (manual arm - manual playback option) is entered and
  - the soft key beneath RUN is pressed.

<<< or >>> "<<<" or ">>>" selects either the ACQ ARM parameter or the CHANNELS parameter for change. "<<<" selects from the left. ">>>" selects from the right.

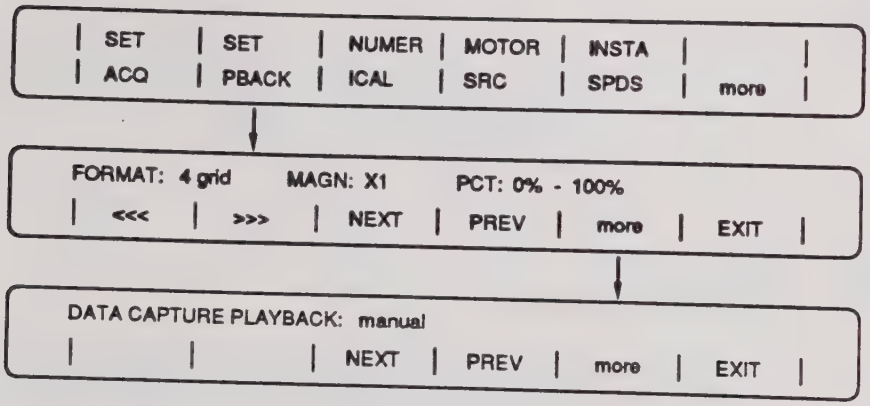
NEXT or PREV "NEXT" or "PREV":

- when ACQ ARM is selected , causes the displayed ACQ ARM parameter to alternate between "manual" and "auto" rearm.
- when CHANNELS is selected, alternates between two sample memory allocation choices: 4 channels with 64k of sample memory or 2 channels with 128k of sample memory.

more "more" alternates the ACQ ARM submenu with the SAMPLE RATE submenu.

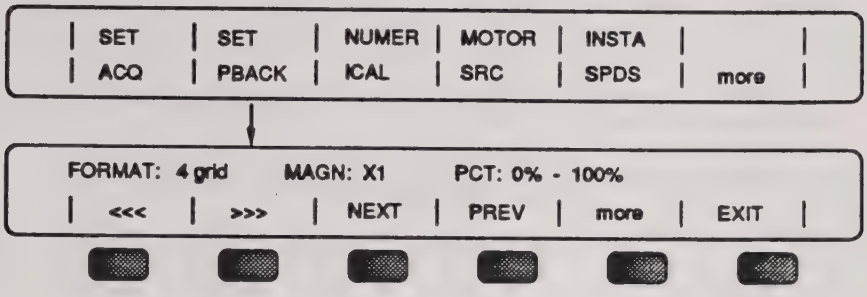
EXIT "EXIT" returns the display to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2— SET PBACK submenus



Pressing the soft key beneath "SET PBACK" invokes two submenus that define the format of the data capture playback, a magnification factor or compression factor for the waveform, and the percentage of the playback to be printed. Whether the playback will be manual or automatic is also specified in the SET PBACK setup.

(SYSTEM) Key Prime Menu: Level 2—
SET PBACK submenu 1



<<< or >>> "<<<" or ">>>" individually selects the three displayed parameters: PCT, MAGN, FORMAT. "<<<" selects from left to right. ">>>" selects from right to left.

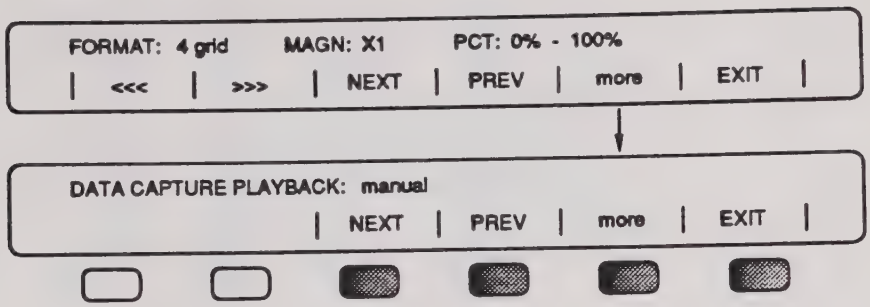
NEXT or PREV "NEXT" or "PREV" can have any of the following effects:

- When FORMAT is the selected parameter, the display scrolls either forward or backward through five format options: 4 grid, 2 grid, 1 grid, XY plot, numeric.
- When MAGN is the selected parameter, the display scrolls either forward or backward through seven playback magnification factors: $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4, 8.
- When PCT is the selected parameter, either increases or decreases the playback percentage in 1% increments from 0% to 100%

more "more" invokes SET PBACK submenu 2.

EXIT "EXIT" returns the recorder to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2—
SET PBACK submenu 2



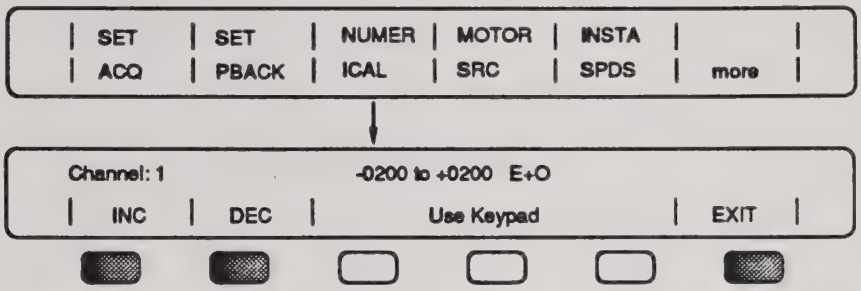
Submenu 2 allows you to specify whether captured data will be played back automatically or manually.

NEXT or PREV "NEXT" or "PREV" causes the display to alternate between "manual" and "automatic."

more "more" toggles the display between submenus 1 and 2.

EXIT "EXIT" returns the recorder to SET PBACK submenu 1.

(SYSTEM) Key Prime Menu: Level 2—
NUMERICAL setup



Pressing the soft key beneath "NUMERICAL" invokes the menu used to specify the conversion factors used when recording in the Datalogger mode. The conversion factors represent the values of the left and right edges of the waveform in the selected channel. These values are used to convert the waveform data into tabular numeric columns of data. The editable parameters of this display include the channel number, the left and right edge values, and an exponent value (E) which is constrained to whole numbers from -2 to +2.

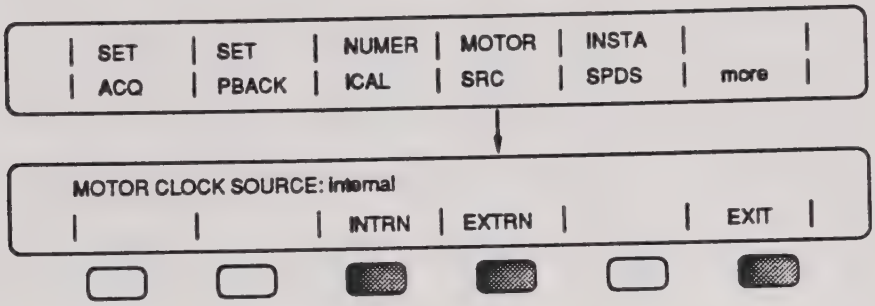
INC or DEC "INC" increases the selected channel to the next higher channel number.

"DEC" decreases the channel to the next lower channel number.

When the NUMERICAL submenu is invoked, the first element (+ or -) of the conversion factors is already blinking indicating that it is selected and can be changed. Use the alphanumeric keypad to change the left- and right-edge values. As each digit is changed, the adjoining digit is automatically selected for change. Also, you can use the arrow keys of the keypad to move through the digits of the conversion factors.

EXIT "EXIT" returns the display to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2— MOTOR SRC submenu



The MOTOR SRC submenu is used to specify whether the speed of the stepper motor clock will be referenced to the DASH IV's internal clock or to an external speed source.

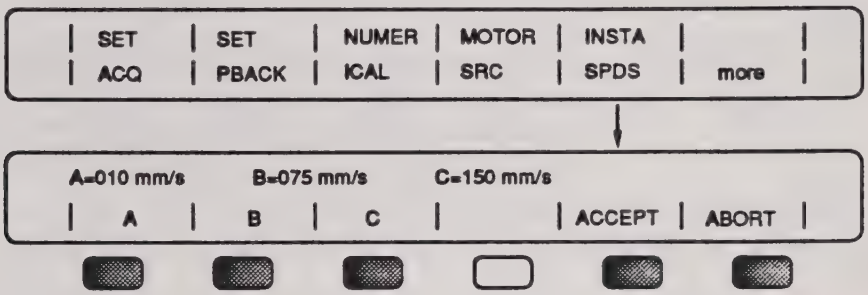
INTRN "INTRN" references the stepper motor clock to the recorder's internal clock.

EXTRN "EXTRN" references the stepper motor clock to an external speed source.

EXIT "EXIT" returns the display to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 2—

INSTA SPDS submenu



Pressing the soft key beneath "INSTA SPDS" invokes the insta-speeds submenu. This submenu is used to program the chart speeds you desire into the [A], [B], and [C] insta-speed keys of the CHART SPEEDS group.

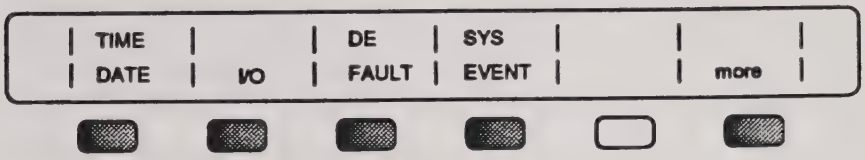
A, B, or C Pressing the soft key beneath "A," "B," or "C" selects the first digit of the key's currently displayed speed for editing.

- Use the arrow keys of the alphanumeric keypad to select the remaining digits of the displayed speed. The right arrow selects digits to the right. The left arrow selects to the left.
- Use the number keys of the alphanumeric keypad to change the selected (blinking) digit.
- Use the [MM/SEC], [MM/MIN], [MM/HR] keys of the CHART SPEEDS group to change the displayed speed range.
- If you press one of the fixed speed keys (1, 5, ... 200) of the CHART SPEEDS group when you are programming the [A], [B], [C] keys, the selected insta-speed key immediately takes on the value of the fixed speed key. This makes the insta-key redundant to the fixed speed key.

ACCEPT When you have finished defining the insta-speeds you desire, press the soft key beneath "ACCEPT." This causes the recorder to accept and implement the new insta-speeds. When the soft key beneath "ACCEPT" is pressed, the display returns to Level 2 of the [SYSTEM] key prime menu.

ABORT "ABORT" instructs the recorder to disregard any ongoing reprogramming of the insta-speed keys and returns the display to Level 2 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 3



When the soft key beneath "more" in Level 2 of the [SYSTEM] key prime menu is pressed, Level 3 of the prime menu is displayed.

TIME DATE "TIME DATE" invokes the menu used to set the recorder's clock and calendar.

I/O "I/O" invokes the menus that define host-control input/output communications parameters and implement down-loading of software upgrades.

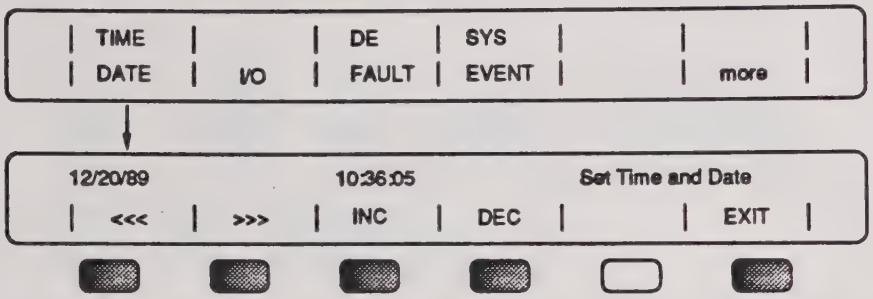
DEFAULT "DEFAULT" invokes the menu that implements default values for any of four recording parameters: channel annotation, zero, numerical, and channel order.

SYS EVENT "SYS EVENT" in channels 1, 3, and 4, enables or disables printing of system event markers.

"SYS EVENT" in channel 2, enables or disables printing either of a system event marker or of timing marks.

more Pressing the soft key beneath more invokes Level 1 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 3—
TIME DATE submenu



The TIME DATE submenu is used to set the recorder's real-time clock and calendar.

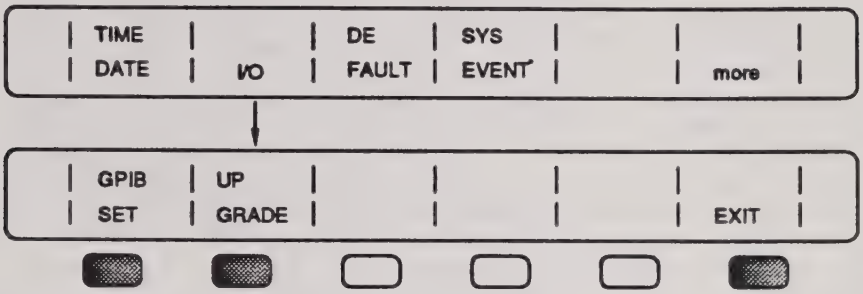
<<< or >>> "<<<" or ">>>" individually selects each digit of the date and time. ">>>" selects from the right. "<<<" selects from the left.

INC "INC" increases the currently selected digit.

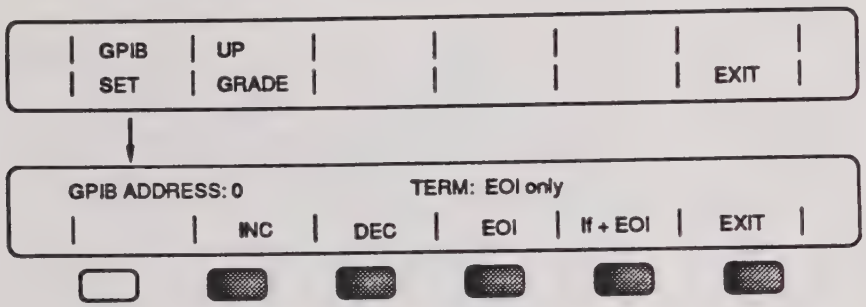
DEC "DEC" decreases the currently selected digit.

EXIT "EXIT" returns the display to Level 3 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 3— I/O submenus



Pressing the soft key beneath the "I/O" selection invokes a two-function menu. The GPIB SET selection is used to define the GPIB communications setup for host control operation. The UPGRADE selection is used to quickly and easily accomplish upgrades to the DASH IV's operating system software. Each of these choices are individually explained below.



Pressing the soft key beneath "GPIB SET" invokes the menu that configures the GPIB communications interface. The GPIB SET menu specifies a GPIB address and a terminator for all command sequences.

INC "INC" increases the number specifying the GPIB address. Addresses 0 through 30 are available.

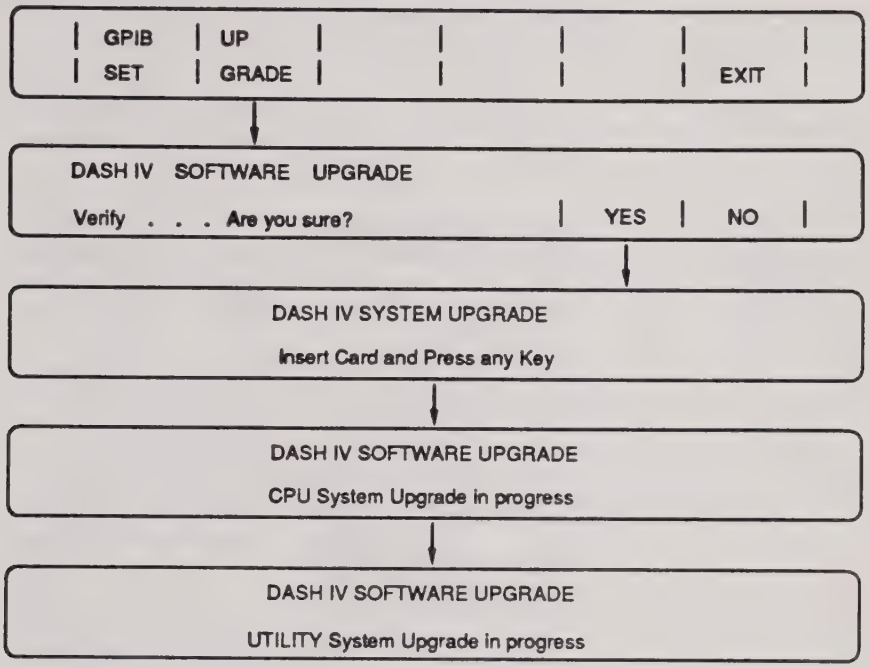
DEC "DEC" decreases the number specifying the GPIB address.

EOI "EOI" (end or identify) affects the displayed TERM (terminator) parameter by specifying that only an EOI pulse will be recognized as a terminator.

lf + EOI "lf+ EOI" specifies that either an lf (line feed) control character or an EOI pulse will be recognized as a terminator.

EXIT "EXIT" returns the display Level 3 of the [SYSTEM] key prime menu.

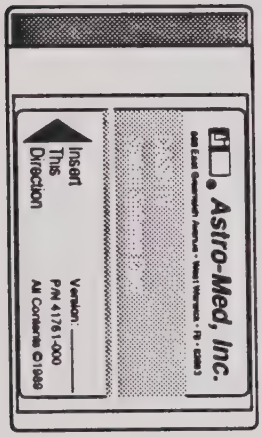
(SYSTEM) Key Prime Menu: Level 3—
I/O submenus / UPGRADE submenus



The process of upgrading the DASH IV's system software is extremely simple. The process is described immediately below in "Downloading Operating System Software."

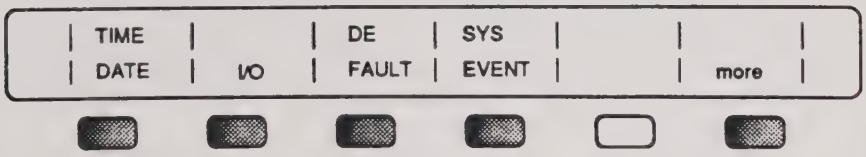
The process of downloading new operating system software requires an Astro-Med DASH IV System Software RAM Card, P/N 41761-000.

■ front

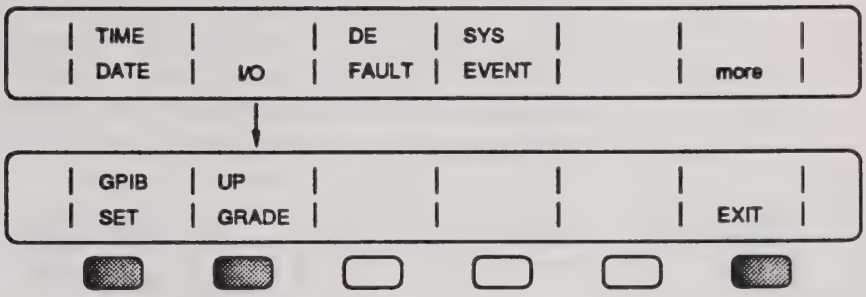


■ rear

1 Press the front-panel [SYSTEM] key and press the soft key beneath "more" until the Level 3 of the [SYSTEM] key prime menu is reached.

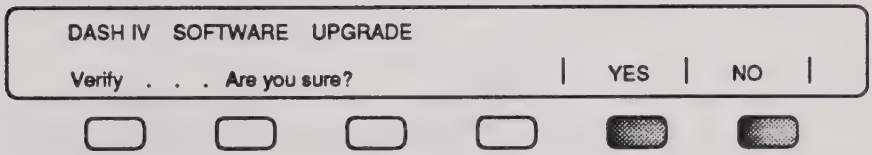


2 Press the soft key beneath "I/O" to access the UPGRADE function.

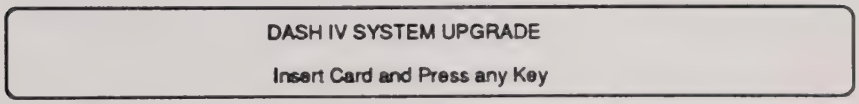


3 Press the soft key beneath "UPGRADE."

To ensure that the current system software is not unintentionally replaced, the upgrade process gives you a final opportunity to confirm your intent to upgrade.

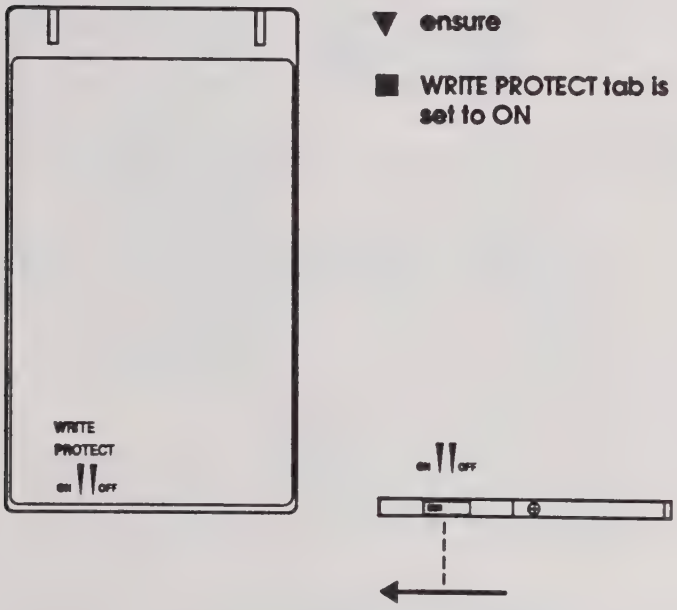


When you press the soft key beneath "YES," you are prompted to insert the Astro-Med System Software RAM Card.

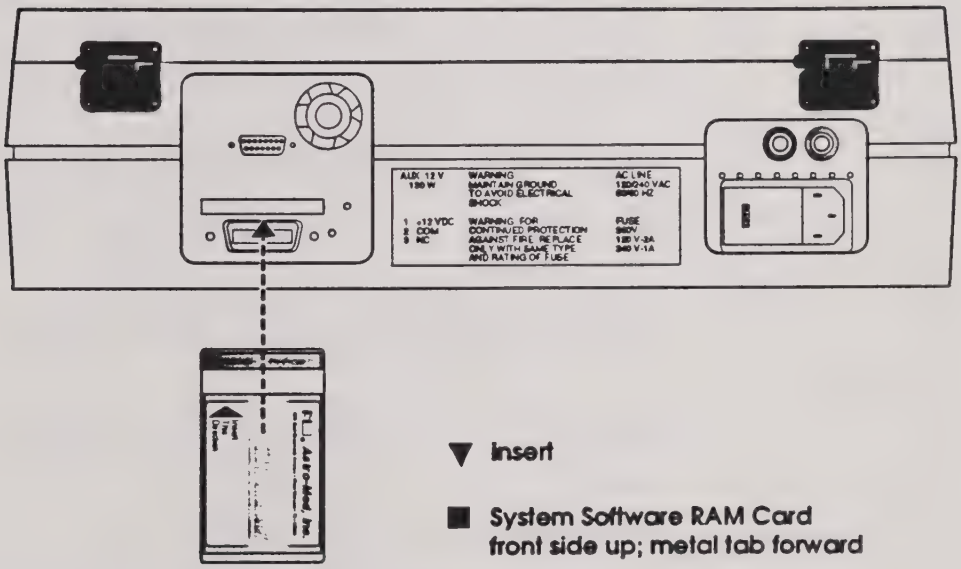


CAUTION

Ensure that the write-protect tab on the Astro-Med System Software RAM Card is pushed to the ON setting. This will protect the operating system software resident on the card from being accidently over-written and, consequently, lost.



4 Insert the Astro-Med System Software RAM Card into the rear-panel RAM card slot.

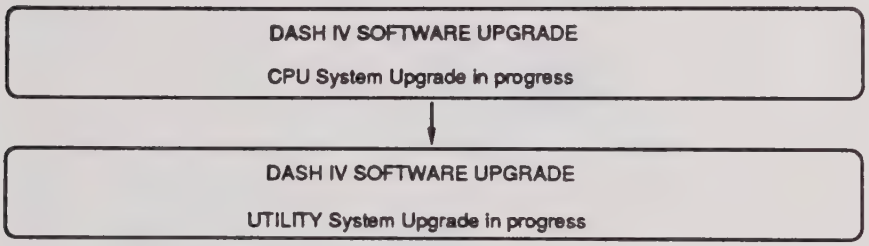


▼ Insert

■ System Software RAM Card front side up; metal tab forward

5 Press any front-panel soft key.

The UPGRADE process is immediately initiated. A message is automatically displayed indicating the downloading of new CPU system software. This is followed by an automatic message indicating the downloading of new UTILITY system software.



6 When the upgrade has been completed, the DASH IV will return to its previous mode of operation.

NOTE

After every system software upgrade:

- enter the DEFAULT submenu and perform a system-wide default by pressing the soft key beneath "SYS."
- press the front-panel [CALIBRATE] key to prompt the DASH IV to perform a self-calibration procedure.

If the upgrade installation should fail, any of the individual messages shown below may be displayed. If an installation failure should occur, restart the DASH IV and repeat the installation process. You may also want to try the forced downloading procedure described on page 4-67. If the problem persists, call the Astro-Med service department at (401) 828-4000.

```
SOFTWARE    UPGRADE
No card installed
```

```
SOFTWARE    UPGRADE
Non-system card installed
```

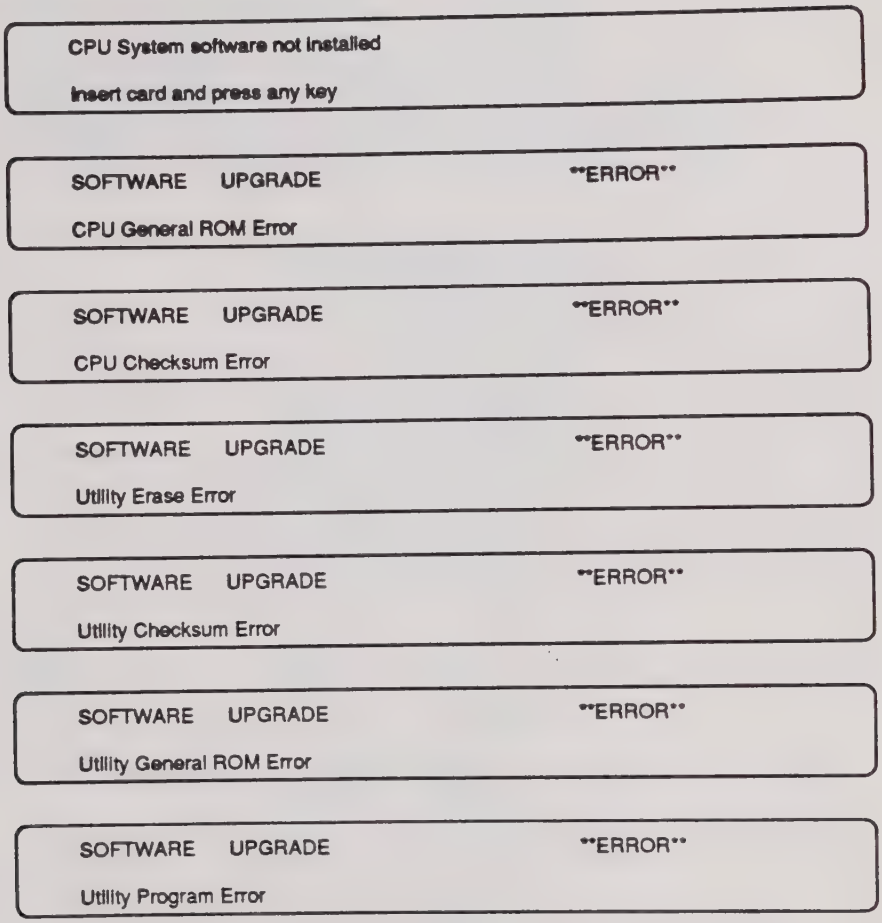
```
Utility System software not installed
Insert card and press any key
```

```
SOFTWARE    UPGRADE                    **ERROR**
Card Error
```

```
SOFTWARE    UPGRADE                    **ERROR**
CPU Program Error
```

```
SOFTWARE    UPGRADE                    **ERROR**
CPU Erase Error
```

UPGRADE Error Message Displays (continued)



If, after several attempts, the DASH IV fails to accept new operating system software, you may wish to try a forced download of the software. Follow the steps below to implement a forced download of operating system software.

1. Ensure that the DASH IV is turned off.

2. Insert the Astro-Med System Software RAM Card into the rear-panel RAM card slot.

3. Press down on the [FNC] key of the alphanumeric keypad.

4. Turn the DASH IV on.

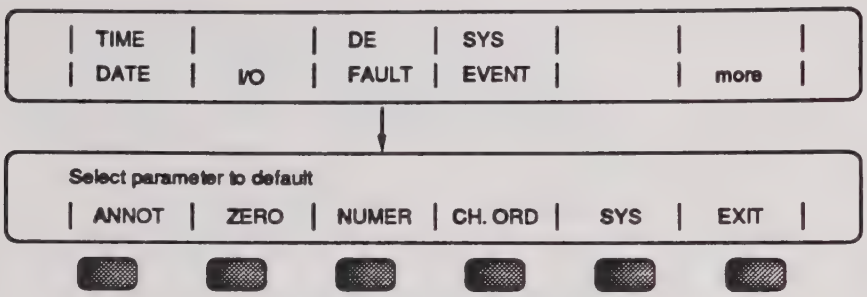
   The recorder will display the following message.

   FORCED System Upgrade. Release [FNC],
   Insert card and press any key

5. Press any of the recorder's keys.

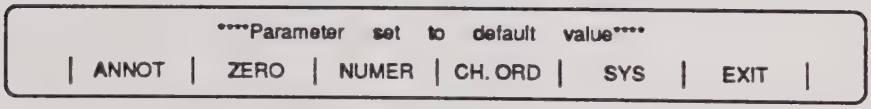
   The forced download process will automatically initiate and complete.

(SYSTEM) Key Prime Menu: Level 3— DEFAULT submenu



Pressing the soft key beneath "DEFAULT" invokes a submenu that allows you either (1) to individually reset four setup parameters to their default values or (2) to reset all system setups to their default values. Setting any parameter to its default status affects all of the recorder's channels.

When the soft key beneath any parameter is pressed, the display will show the following message:



ANNOT "ANNOT" causes all channel annotation buffers to contain an alphanumeric channel identifier: CHANNEL 1, CHANNEL 2, etc.

ZERO "ZERO" causes all zero baselines to be set to 0.

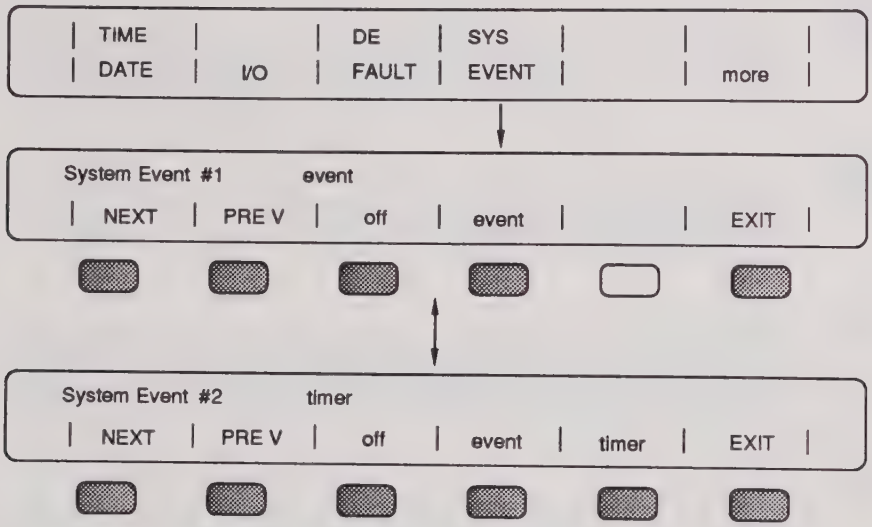
NUMER "NUMER" causes the left and right edge Datalogger values for all channels to be 0000 and +1000 E + -1 respectively.

CH. ORDER "CH. ORDER" causes all channels to be printed from left to right across the chart in progressive numerical order.

SYS "SYS"sets all current system recording parameters to system default values.

EXIT "EXIT" returns the display to Level 3 of the [SYSTEM] key prime menu.

(SYSTEM) Key Prime Menu: Level 3—
SYS EVENT submenu



Pressing the soft key beneath "SYS EVENT" invokes the submenus that enable or disable printing of the four system event markers that are standard with your DASH IV.

NEXT or PREV "NEXT" or "PREV" selects the number of the system event marker that will be enabled or disabled.

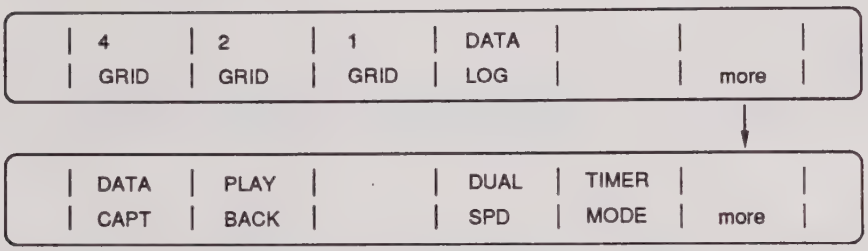
off "off" suppresses printing of the selected system event marker.

event "event" causes the system event marker to be printed in the selected channel.

When 2 is the selected system event marker, a timing mark option becomes available. The timing mark option appears in the menu as "timer."

timer "timer" causes system event marker #2 to be printed as timing marks. The word "timer" appears in the top line of the display opposite "System Event #2."

EXIT "EXIT" returns the display to Level 3 of the [SYSTEM] key prime menu.



With the Data Capture (DC-45) option installed, the DASH IV offers eight modes of operation. The recorder's [MODE] key is used to access these modes of operation. This discussion is based on a recorder equipped with all software options.

Pressing the [MODE] key invokes the first of two displays that comprise the [MODE] key prime menu. For clarity, the first display is discussed as Level 1 of the [MODE] key prime menu. The second display is Level 2.

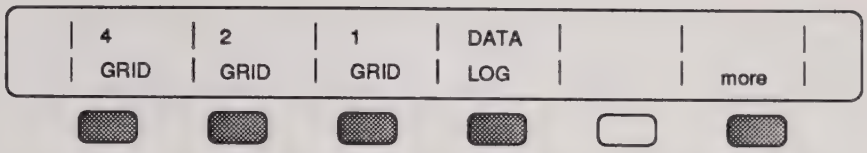
Pressing the soft key beneath the following selections causes the recorder to begin immediate operation in the selected mode:

- 4 GRID
- 2 GRID
- 1 GRID
- DATA LOG

Pressing the soft key beneath the following selections invokes submenus that require input before the selected mode is entered.

- DATA CAPT
- PLAYBACK
- DUAL SPD
- TIMER MODE

(MODE) Key Prime Menu: Level 1



When the [MODE] key is pressed, Level 1 of the [MODE] key prime menu is displayed.

4 GRID "4 GRID" immediately enters the recorder into real-time recording in four 28.125mm-wide channels each containing a single waveform. Recording reflects either custom presets defined using the [SYSTEM] key or default presets if default values have not been changed.

2 GRID "2 GRID" immediately enters the recorder into real-time recording in two 56.25mm-wide channels each with two overlapped waveforms. Recording reflects either custom presets defined using the [SYSTEM] key or default presets.

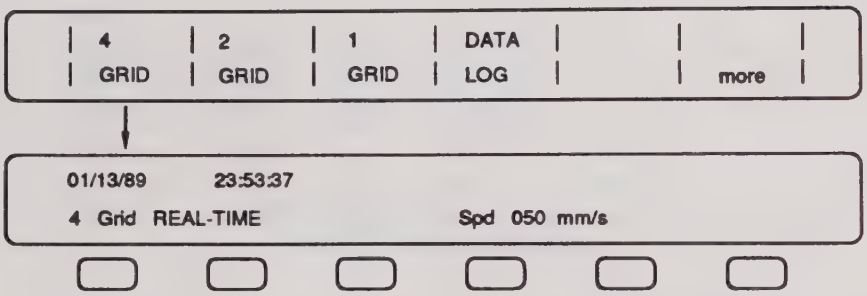
1 GRID "1 GRID" immediately enters the recorder into real-time recording in one 112.5mm-wide channel containing four overlapped waveforms. Recording reflects either custom presets defined using the [SYSTEM] key or default presets.

DATALOG "DATALOG" immediately enters the recorder into Datalogger operation reflecting the values specified in the NUMERICAL setup of the [SYSTEM] key.

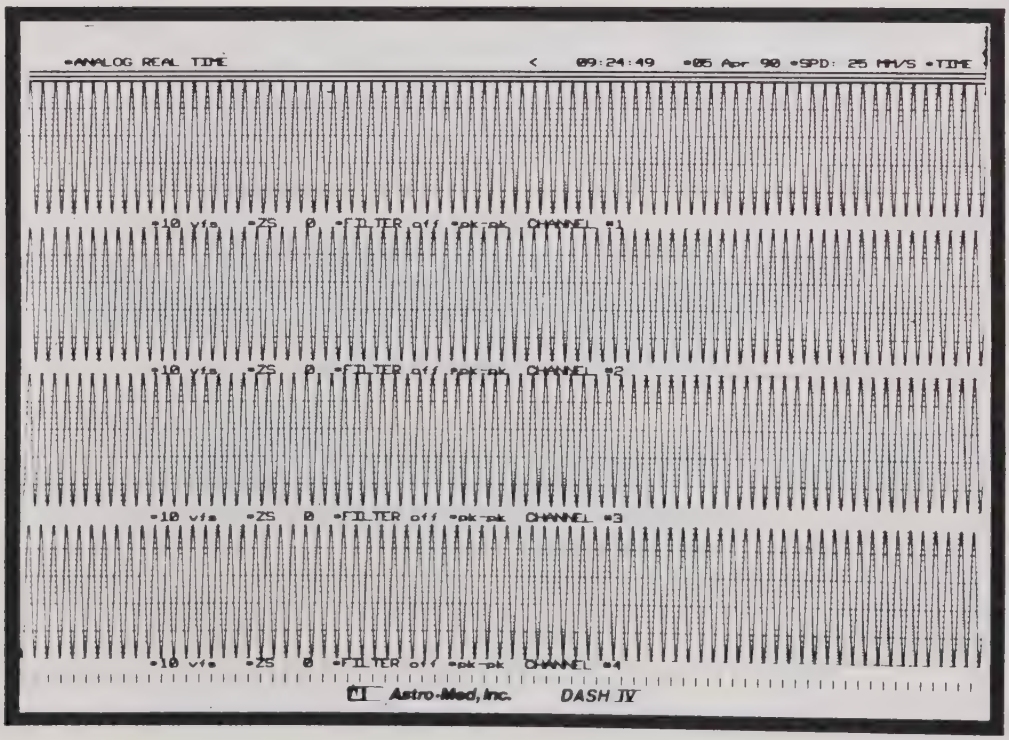
more "more" invokes Level 2 of the [MODE] key prime menu.

(MODE) Key Prime Menu: Level 1—

4 GRID Mode display

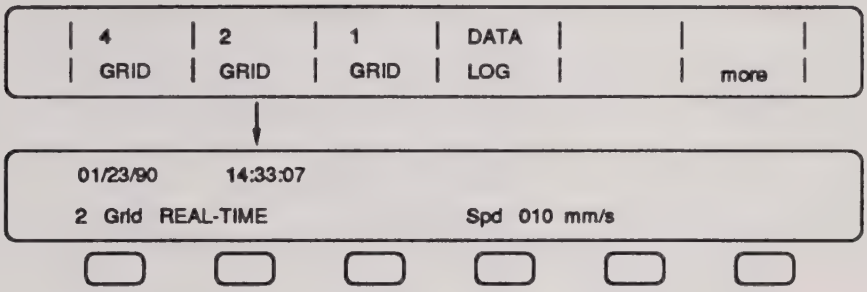


Pressing the soft key beneath "4 GRID" immediately enters the recorder into the 4-channel real-time recording mode and invokes the 4 Grid REAL-TIME display. This format consists of four 28.125mm- wide channels each containing a single waveform.

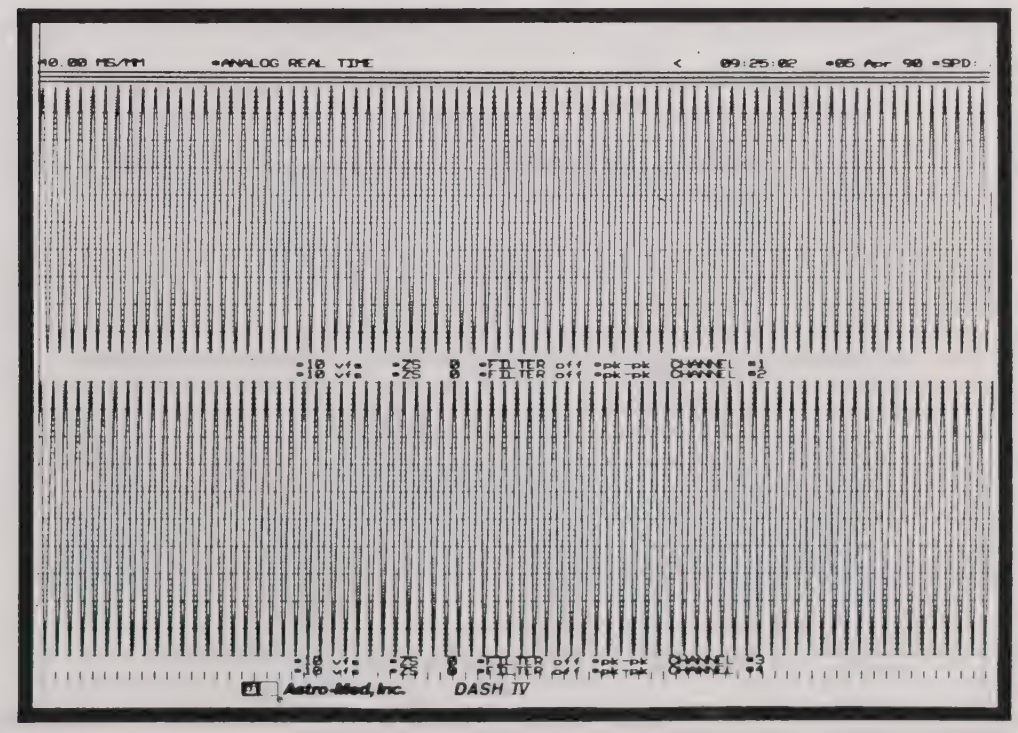


(MODE) Key Prime Menu: Level 1—

2 GRID Mode display

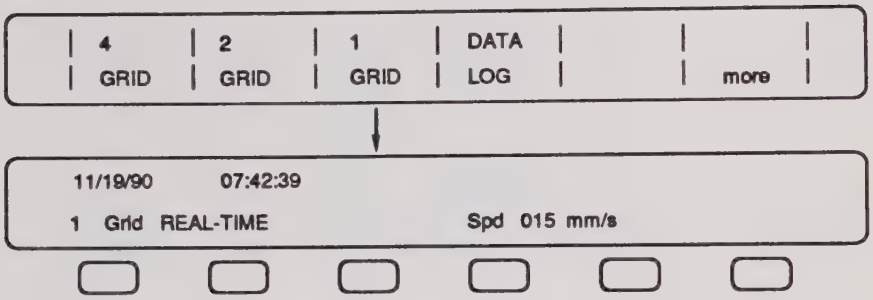


Pressing the soft key beneath "2 GRID" immediately enters the recorder into the 2-channel real-time recording mode and invokes the 2 Grid REAL-TIME display. This format consists of two 56.25mm-wide channels each containing two overlapped waveforms.

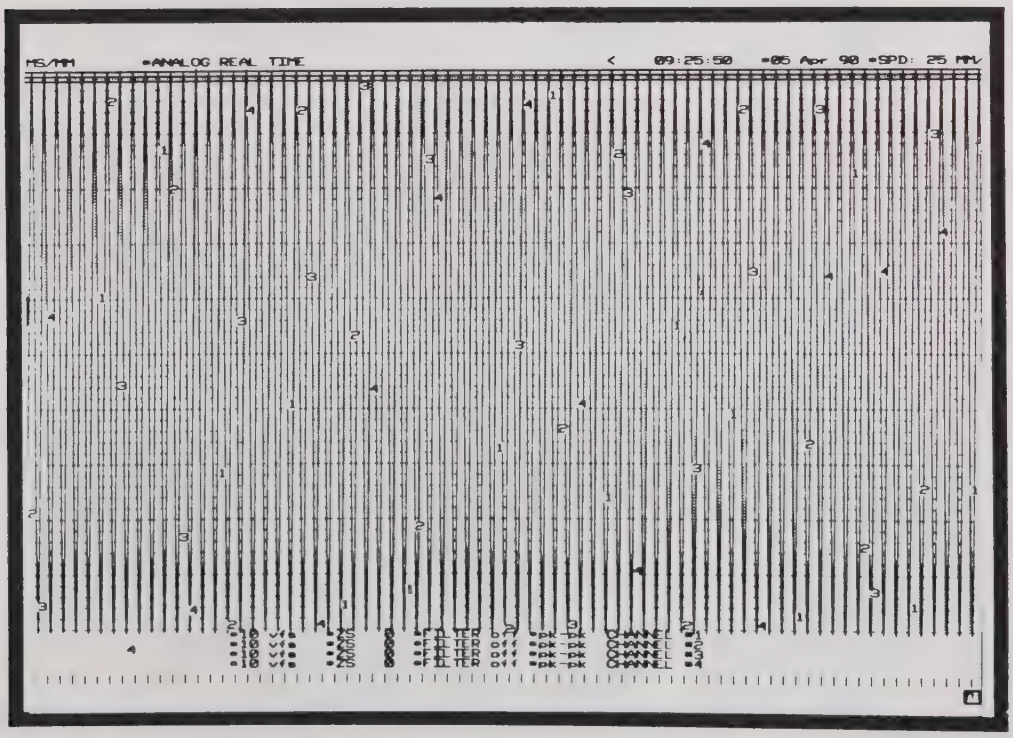


(MODE) Key Prime Menu: Level 1—

1 GRID Mode display

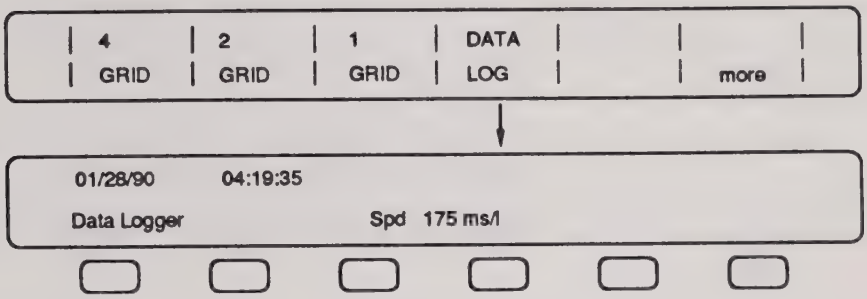


Pressing the soft key beneath "1 GRID" immediately enters the recorder into the single-channel real-time recording mode and invokes the 1 Grid REAL-TIME display. This format consists of one 112.5mm- wide channel containing four overlapped waveforms.

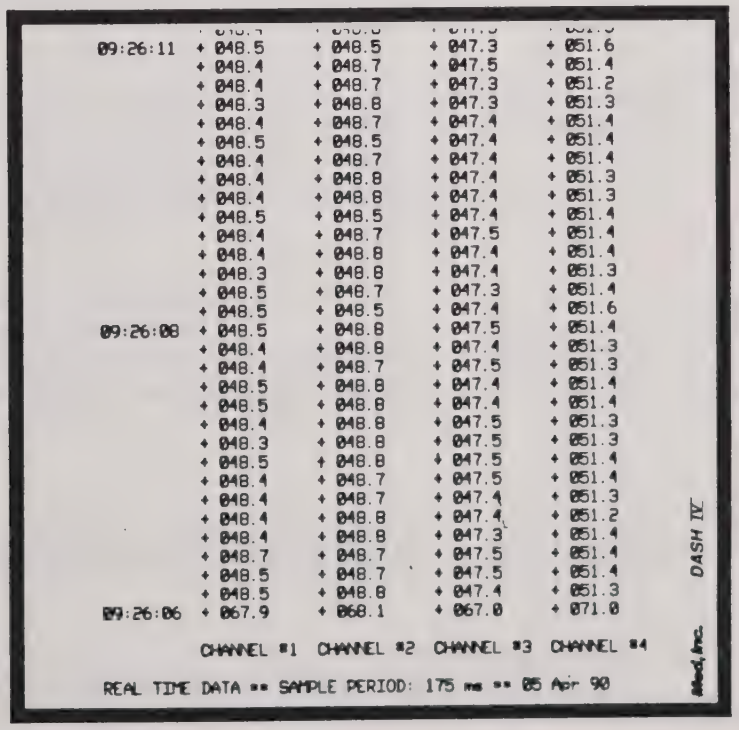


(MODE) Key Prime Menu: Level 1—

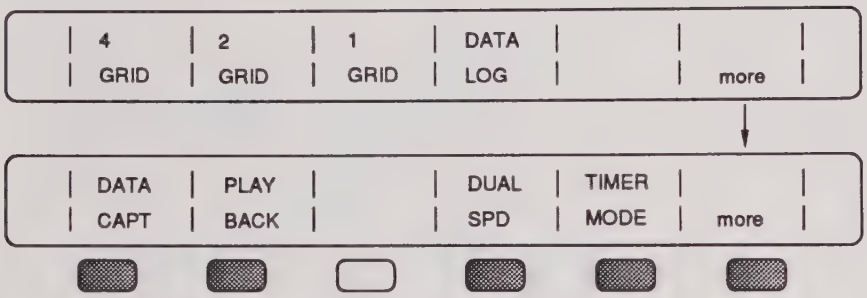
DATA LOG Mode display



Pressing the soft key beneath "DATA LOG" immediately enters the recorder into the Datalogger real-time recording mode and invokes the Datalogger display. This format consists of four columns of tabular numeric data.



(MODE) Key Prime Menu: Level 2



When the soft key beneath "more" in Level 1 of [MODE] key prime menu is pressed, Level 2 of the prime menu is displayed.

DATA CAPT "DATA CAPT" invokes the menu that initiates the data capture mode. The capture reflects either custom presets defined using the SET ACQ menus of [SYSTEM] key or default presets.

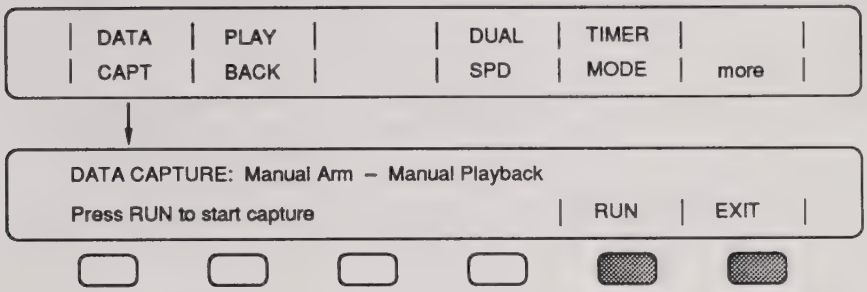
PLAYBACK "PLAYBACK" immediately initiates playback of a data capture acquisition. The playback reflects either custom presets defined using the SET PBACK menus of the [SYSTEM] key or default presets.

DUAL SPD "DUAL SPD" enters the recorder into either timed dual speed operation, triggered dual speed operation, or a combination of both.

TIMER MODE "TIMER MODE" enters the recorder into timed operation.

more "more" invokes Level 1 of the [MODE] key prime menu.

(MODE) Key Prime Menu: Level 2—
DATA CAPT Mode menu



NOTE

During data capture operations, an Astro-Med Data Capture RAM Card, P/N 41727-512, must be inserted in the recorder's rear panel RAM card slot. Before performing data captures, see "Performing Data Capture Operations" on the immediatedly following pages.

Pressing the soft key beneath "DATA CAPT" invokes the menu that initiates a data acquisition. The top line of the menu displays

- the rearm preference defined in the SET ACQ setup of the [SYSTEM] key.
- the playback preference defined in the SET PBACK setup of the [SYSTEM] key.

Trigger rearm and playback operations can be either manual or automatic.

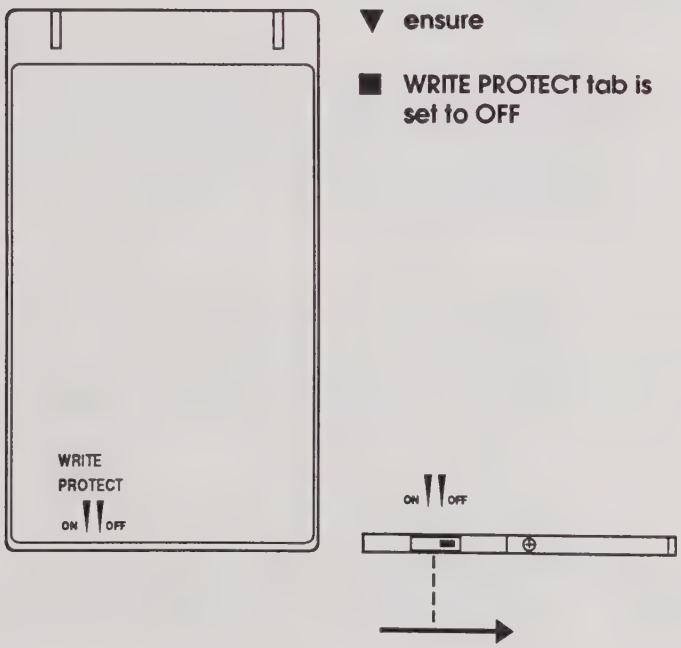
RUN "RUN" immediately initiates a data capture.

EXIT "EXIT" returns the recorder to Level 2 of the [MODE] key prime menu.

In order to perform data captures, the Data Capture option (DC-45) must be installed in your DASH IV. In addition, the data capture process requires the use of an Astro-Med Data Capture RAM Card. Follow the steps below to physically prepare the DASH IV to perform data captures.

1 Ensure that the RAM Card's write-protect tab is set to the OFF position.

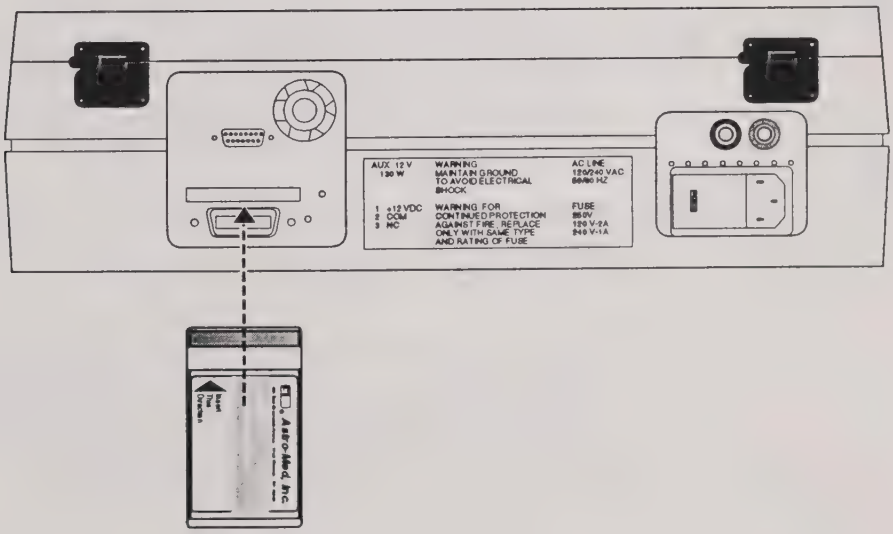
Data will not write to the card if write protection is ON.



2 Locate the recorder's rear-panel RAM slot and insert the Astro-Med Data Capture RAM Card front-side up into the slot.

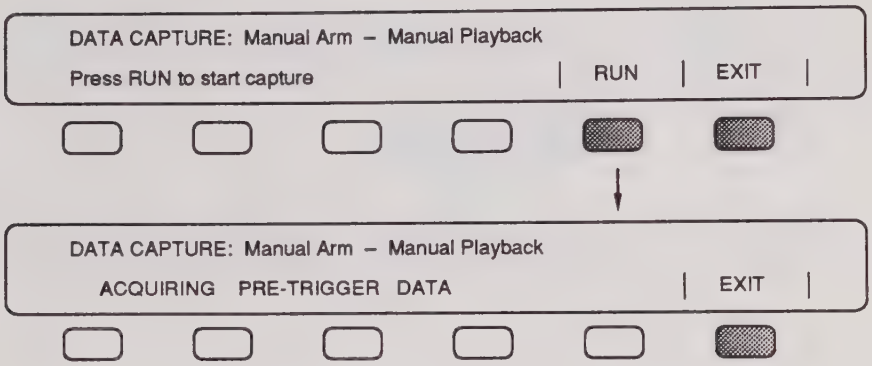
CAUTION

Do not confuse the Data Capture RAM Card, P/N 41727-512 with the System Software RAM Card, P/N 41761-000.



3 Use the [MODE] key to access the Data Capture mode.

Displays Resulting from the Manual Playback Option

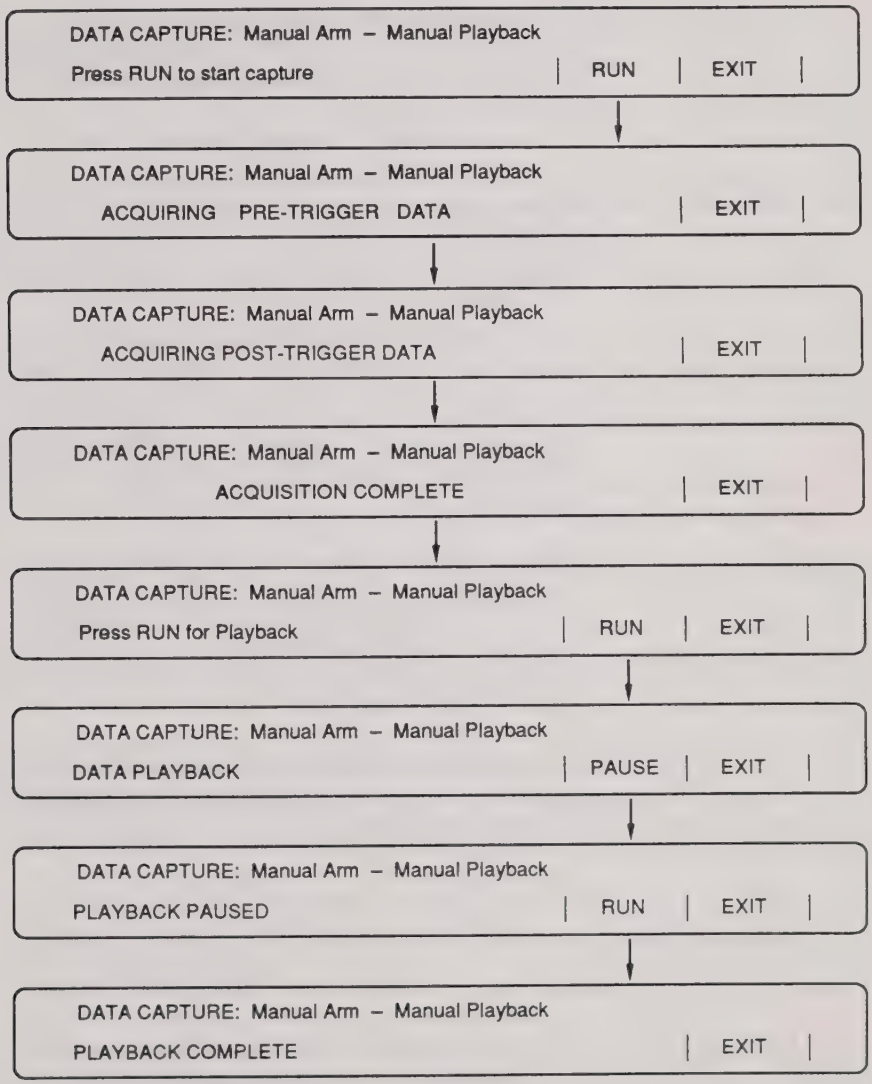


RUN "RUN" results in a message indicating that pre-trigger data is being acquired. This message will remain until a manual or automatic trigger is sensed or until the soft key beneath "EXIT" is pressed.

EXIT "EXIT" aborts the acquisition and returns the recorder to its base display.

When a manual or automatic trigger is sensed, a sequence of displays is initiated. Manual playback of an acquisition and automatic playback of an acquisition result in slightly different playback message sequences. If manual playback has been specified, the following menu sequence is observed.

Displays Resulting from the Manual Playback Option (continued)



After a data capture has been completed, the display automatically indicates ACQUISITION COMPLETE. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

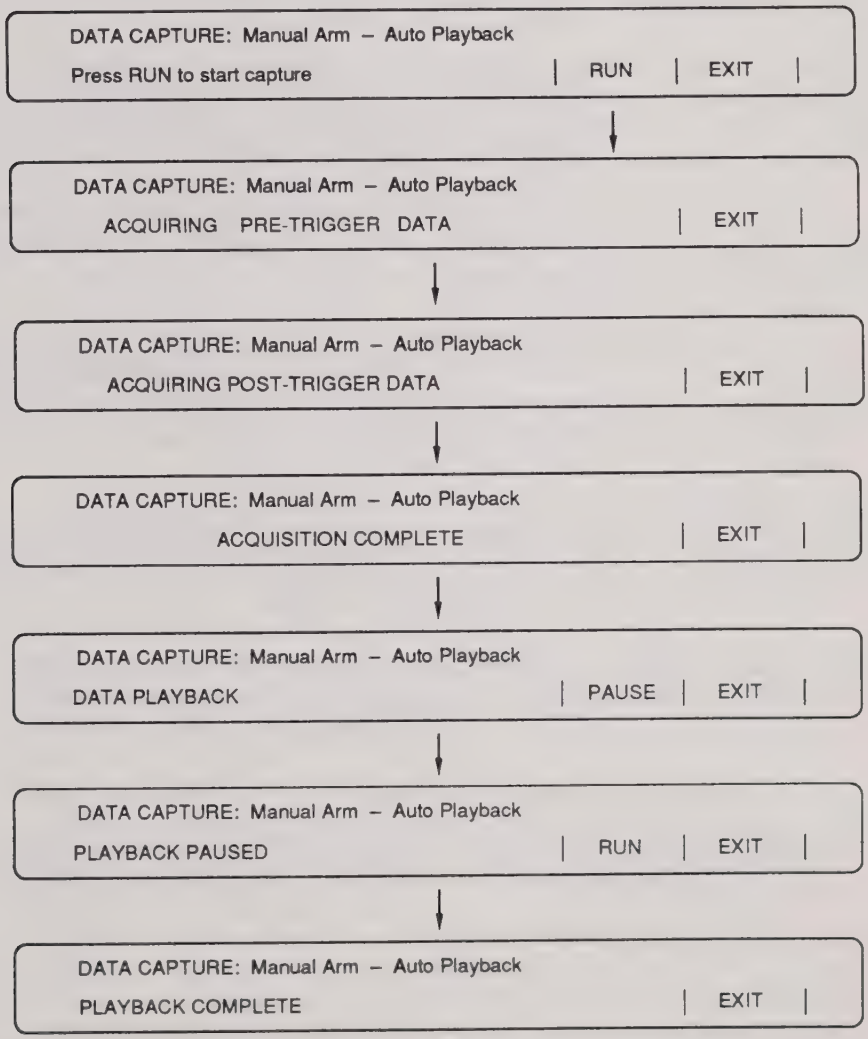
Because this is the manual playback option, the display proceeds to a menu that prompts you to "Press RUN for Playback." Press the soft key beneath "RUN" to initiate the playback. Press the soft key beneath "EXIT" to return to the recorder's base display.

When the playback has been initiated, the display will change and present you with an option to pause the playout of the captured data. Press the soft key beneath "PAUSE" to temporarily halt the playout of the captured data. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

If the playback has been paused, the display will change to present you with the option of continuing the playback. Press the soft key beneath "RUN" to resume the playout. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

The display automatically informs you when the playback has been completed. Press the soft key beneath "EXIT" to return to the recorder's base display.

If automatic playback has been specified, the following menu sequence is observed.



After a data capture has been completed, the display automatically indicates ACQUISITION COMPLETE. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

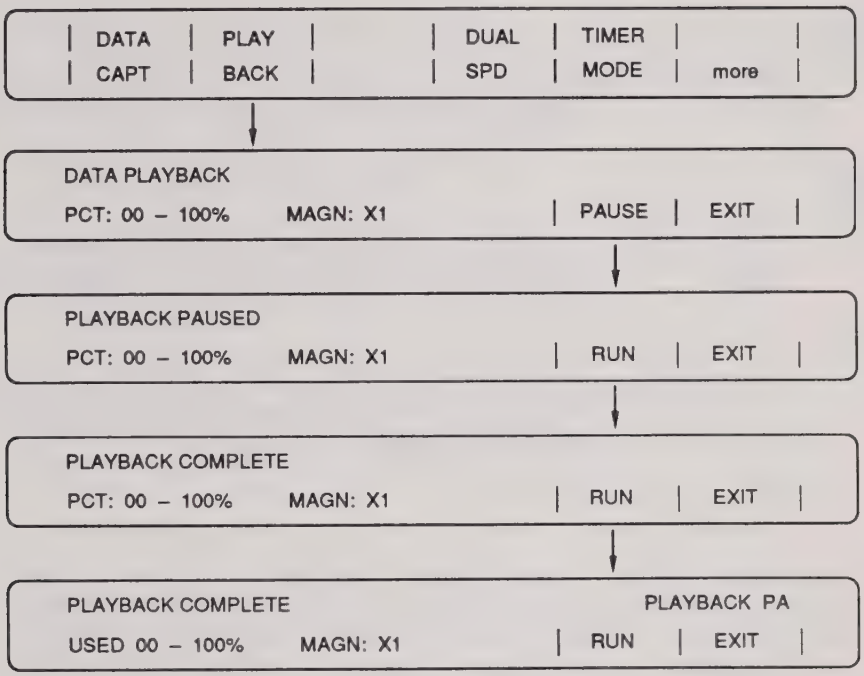
Because this is the automatic playback option, data playback is initiated automatically after the acquisition has been completed. The DATA PLAYBACK display is shown while the playout is underway. Press the soft key beneath "PAUSE" if you want to temporarily halt the playout. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

If the playback has been paused, the display will change to present you with the option of continuing the playback. Press the soft key beneath "RUN" to resume the playout. If you do not want to proceed, press the soft key beneath "EXIT" to return to the recorder's base display.

The display automatically informs you when the playback has been completed. Press the soft key beneath "EXIT" to return to the recorder's base display.

(MODE) Key Prime Menu: Level 2—

PLAYBACK Mode menus



Pressing the soft key beneath "PLAYBACK" immediately initiates playback of captured data. Data playback is automatic and the above menu sequence is observed.

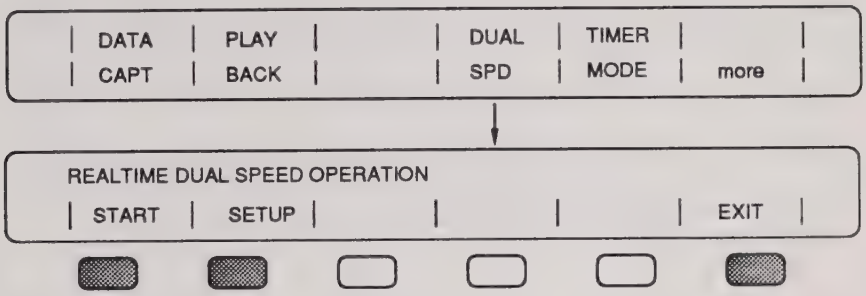
Each menu of the sequence displays the percentage of the acquisition that is being being played out and the magnification factor applied to the playback data. These parameters are defined in the SET PBACK setup.

PAUSE "PAUSE" in the DATA PLAYBACK display temporarily halts the playout and causes the display to change to PLAYBACK PAUSED.

RUN "RUN" in the PLAYBACK PAUSED menu resumes printing of the playback. When the playback has finished, the PLAYBACK COMPLETE display is automatically shown.

Pressing the soft key beneath "RUN" in the PLAYBACK COMPLETE menu causes an automatic repetition of the same data playback.

(MODE) Key Prime Menu: Level 2—
DUAL SPD Mode submenus



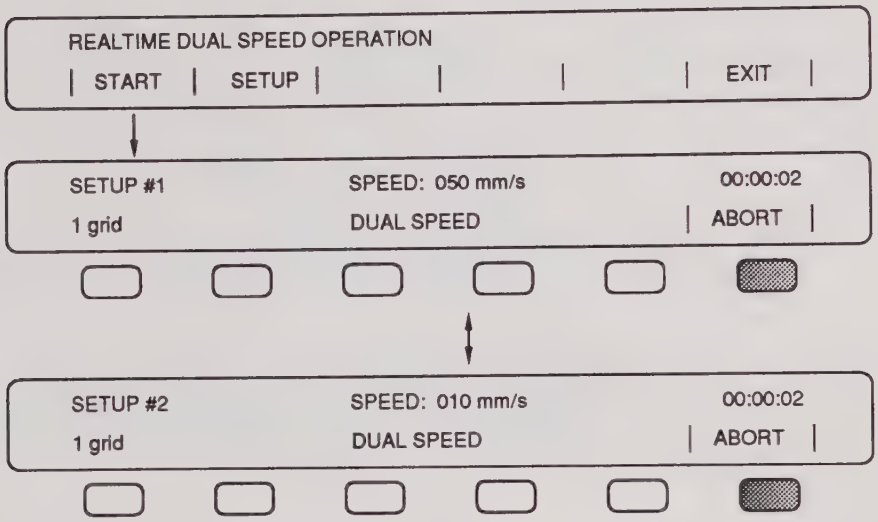
Pressing the soft key beneath "DUAL SPD" invokes the REAL-TIME DUAL SPEED OPERATION menu. This menu offers two options: "START" and "SETUP."

START "START" immediately initiates dual speed recording. Recording will reflect all current dual speed parameter settings as defined in the SETUP submenus.

SETUP "SETUP" provides access to the menus required to define dual speed parameters.

EXIT "EXIT" returns the recorder to its base display.

(MODE) Key Prime Menu: Level 2—
DUAL SPD START submenus



Pressing the soft key beneath "START" in the REAL-TIME DUAL SPEED OPERATION menu immediately initiates dual speed recording and invokes a display indicating the current setup for SPEED 1 or SPEED 2.

SETUP #1 indicates the combination of speed and duration or trigger defined for SPEED 1 in the SETUP submenus. These parameters are shown in the top line of the display.

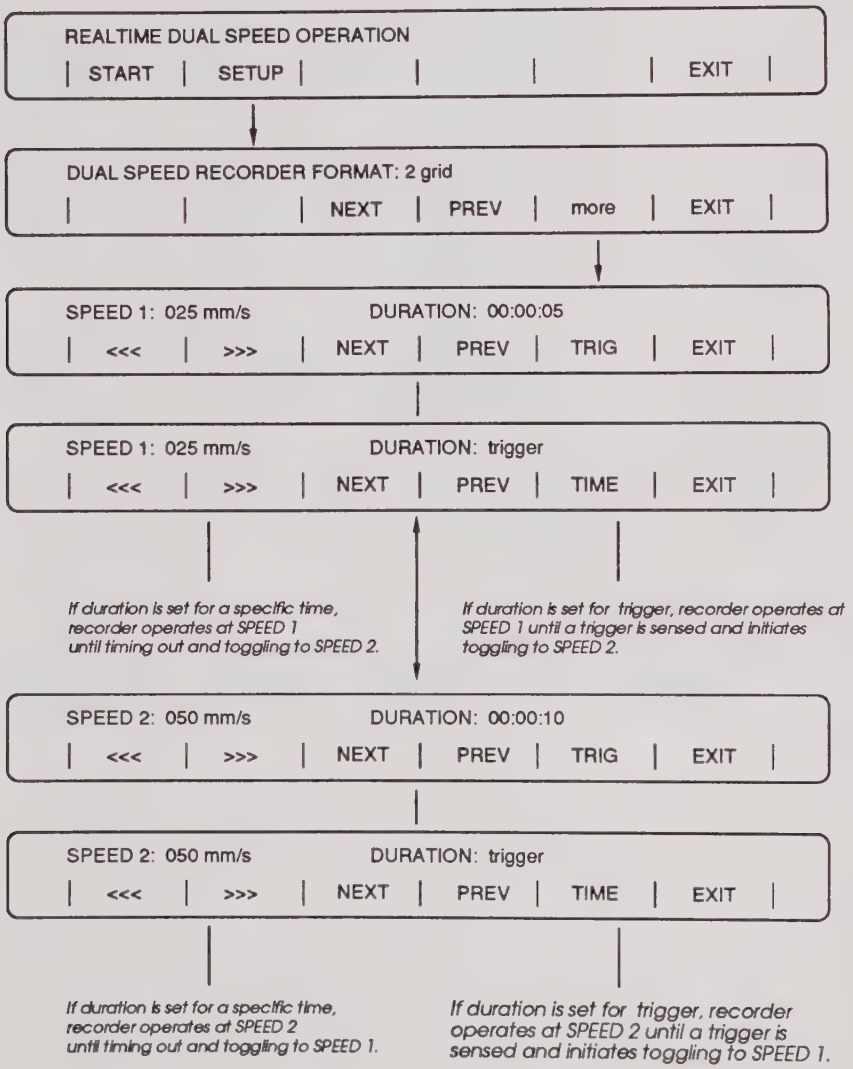
- *If a time duration is shown in the right hand corner of the display, the recorder will operate at the listed speed until the duration times out and the recorder toggles to SETUP #2.*

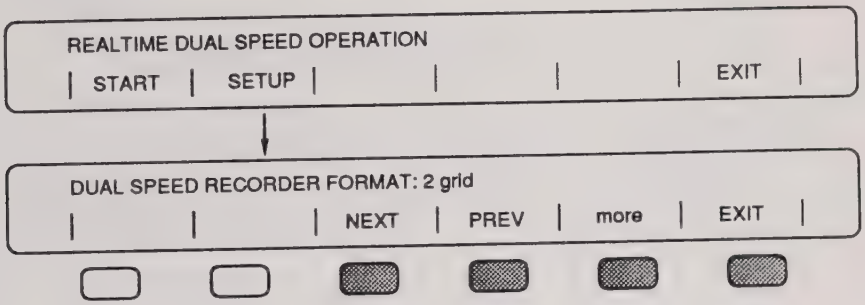
- *If "trigger" is shown in the right hand corner of the display, the recorder will operate at the listed speed until a predefined trigger is sensed and the recorder toggles to SETUP #2.*

If SETUP #2 is displayed, operation is identical except that the recorder toggles to SETUP #1 upon time-out or when a trigger is sensed.

ABORT "ABORT" returns the recorder to its base display.

Dual Speed menu sequence



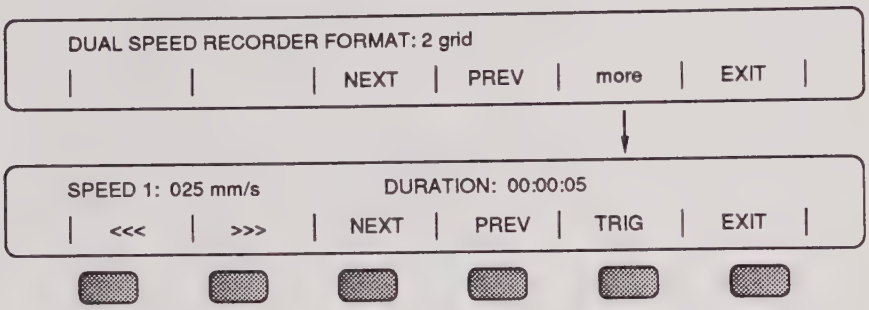


Pressing the soft key beneath "SETUP" initially invokes the menu used to specify a format for the real-time data.

NEXT or PREV "NEXT" or "PREV" in the DUAL SPEED RECORDER FORMAT menu scrolls either forward or backward through the available format options: 1 grid, 2 grid, or 4 grid.

more "more" invokes menus that allow you to define (1) the two speeds which the recorder will toggle between and (2) a time duration or trigger. The recorder will toggle as a result of either the time-out of predefined time duration or the sensing of a predefined trigger.

EXIT "EXIT" causes the recorder to return to the REALTIME DUAL SPEED OPERATION display.



Pressing the soft key beneath "more" in the DUAL SPEED RECORDER FORMAT menu invokes a submenu that allows you to:

- specify the recorder's base speed (SPEED 1) in mm/s, mm/min, or mm/hr.
- specify the alternative speed (SPEED 2) to which the recorder will toggle after SPEED 1 times out or encounters a trigger.
- specify whether SPEED 1 will:

  "countdown" for a prescribed duration of time before toggling to SPEED 2, or

  wait for a predefined trigger before toggling to SPEED 2.
- specify whether SPEED 2 will:

  "countdown" for a prescribed duration of time before toggling to SPEED 1, or

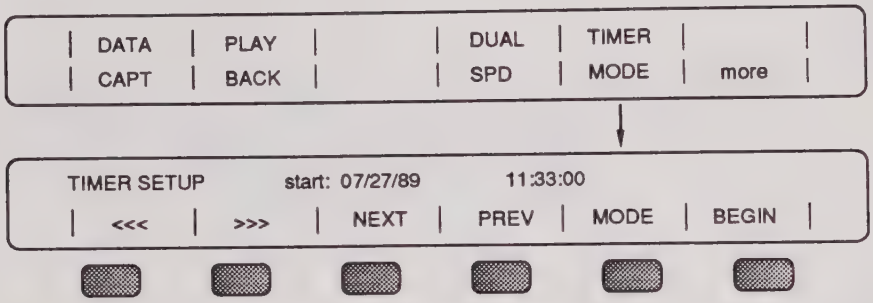
  wait for a predefined trigger before toggling to SPEED 1.

<<< or >>> "<<<" or ">>>" scrolls through the displayed DURATION digits, speed digits, and SPEED X digit. As each digit is selected, it blinks indicating that it can be changed. "<<<" selects from left to right. ">>>" selects from right to left.

NEXT or PREV When the SPEED X digit is selected, pressing the soft keys beneath "NEXT" or "PREV' changes the digit alternately from 1 to 2.

When any speed digit is selected, use the alphanumeric keypad to enter the numbers you want. Use the [MM/SEC], [MM/MIN], and [MM/HR] keys of the CHART SPEEDS group to set the desired range.

When the digits opposite DURATION are selected, pressing the "NEXT" or "PREV" keys selects the next higher or lower number. The first numeric pair represents hours. This parameter can be set between 0 and 23. The second numeric pair is minutes and the third is seconds. These parameters can be set between 0 and 59.



Pressing the soft key beneath "TIMER MODE" invokes the TIMER SETUP menu. The TIMER SETUP menu and its submenus enable the recorder to operate automatically between a predefined start time and end time.

<<< or >>> "<<<" or ">>>" scrolls through the time, date, and start/stop parameters. "<<<" selects from the left. ">>>" selects from the right. As each parameter is selected, it blinks indicating that it can be changed.

NEXT or PREV Pressing the soft key beneath "NEXT" or "PREV":

- **when the start/stop parameter is selected,** alternates between "start" and "stop." "start" indicates that the displayed date and time are when recording will initiate. "stop" indicates that the displayed date and time are when recording will cease.

- **when the month, day, or year numeric pair of the date parameter is selected,** changes the numeric pair to the next higher or lower digit. If "start" is indicated in the display, this will be the start date. If "stop" is indicated in the display, this will be the stop date.

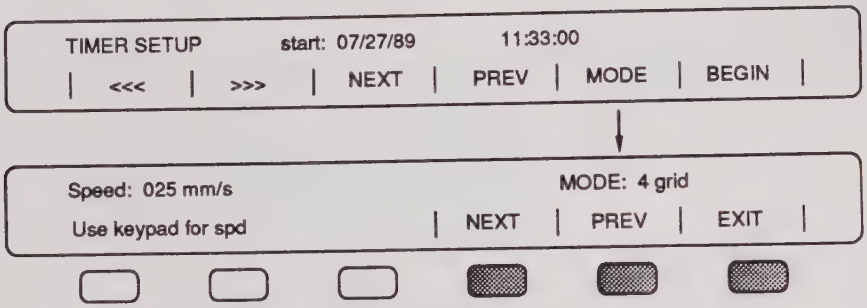
- **when the second, minute, or hour numeric pair is selected,** changes the numeric pair to the next higher or lower digit. If "start" is indicated in the display, this will be the start time. If "stop" is indicated in the display, this will be the stop time.

MODE "MODE" invokes the menu used to select a recording mode and chart paper speed.

BEGIN "BEGIN" immediately enters the recorder into timed operation.

(MODE) Key Prime Menu: Level 2—

TIMER SETUP submenu / mode soft key



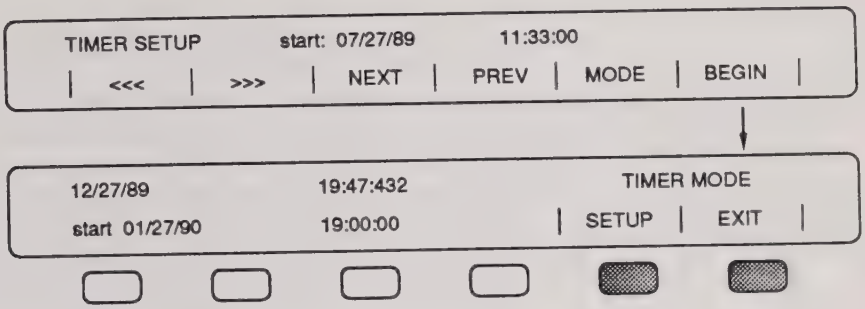
Pressing the soft key beneath "MODE" in the TIMER SETUP submenu invokes the menu used to choose the recording format in which waveform data will be presented when recording in the TIMER mode.

NEXT or PREV Either "NEXT" or "PREV" changes the recording format parameter shown opposite MODE field in the display's top line. As either key is pressed, the available recording formats are shown: 1 grid, 2 grid, 4 grid, Datalogger.

As each format option is shown, the currently set chart paper speed for that format is shown in the top left corner of the display. The first digit of the speed is automatically selected and blinking indicating that it can be changed. Use the number keys of the alphanumeric keypad to enter a different digit. When one digit is changed, the next digit is automatically selected for change. In this way, any legitimate speed can be implemented for the selected mode.

EXIT "EXIT" returns the recorder to the TIMER SETUP display.

(MODE) Key Prime Menu: Level 2—
TIMER SETUP submenu / begin soft key



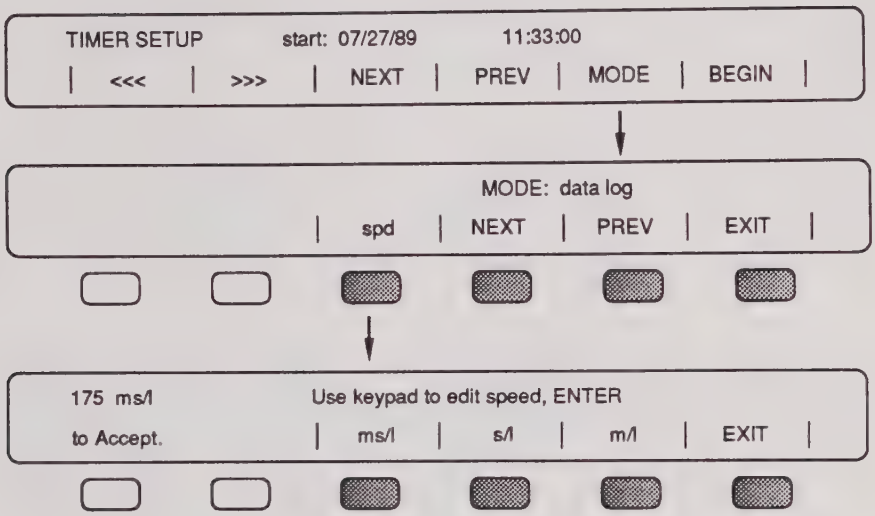
Pressing the soft key beneath "BEGIN" in the TIMER SETUP submenu immediately enters the recorder into timed operation and invokes the TIMER MODE display. The current date, the current time, and TIMER MODE appear in the top line of the display. The lower line of the display indicates the specific date and time at which recording in the TIMER Mode will begin.

SETUP "SETUP" returns the DASH IV to the TIMER SETUP submenu.

EXIT "EXIT" returns the recorder to the base display.

(MODE) Key Prime Menu: Level 2—

TIMER SETUP submenu / mode soft key - datalog



In the Datalogger mode, the sample period determines how frequently waveform data is printed. For example, a sample period of 175 ms indicates that a line of data is printed every 175 milliseconds (175 ms/line). This contrasts with all other modes which print in terms of millimeters per unit of time. As a result, the menu required for timed operation in the Datalogger mode is slightly different from that required by the other recording formats.

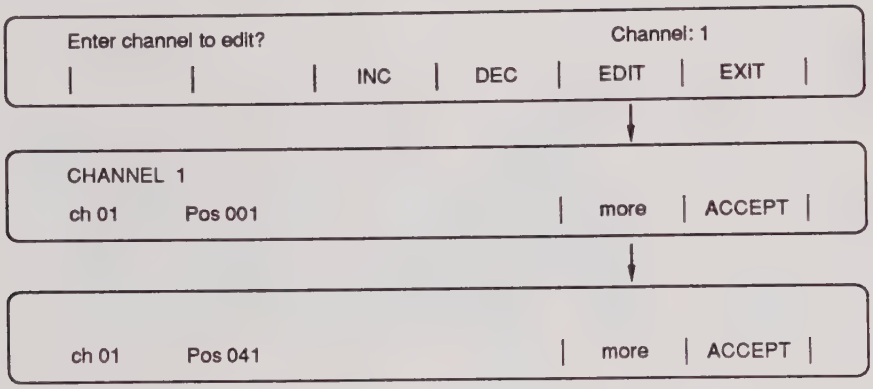
spd When "data log" is the selected mode, pressing the soft key beneath "spd" invokes the menu used to select a printing speed in milliseconds/line, seconds/line, and minutes/line. The currently set speed appears in the display's upper left corner. The first digit of the speed automatically blinks indicating that it is selected and can be changed. Use the number keys of the alphanumeric keypad to change the selected digit. When a digit has been changed, the next number is automatically selected for change.

- Pressing the soft key beneath ms/l causes datalogger data to be printed at a rate measured in milliseconds per line.
- Pressing the soft key beneath s/l causes datalogger data to be printed at a rate measured in seconds per line.
- Pressing the soft key beneath m/l causes datalogger data to be printed at a rate measured in minutes per line.

NEXT or PREV Either "NEXT" or "PREV" changes the recording format parameter shown opposite MODE in the display's top line. As either key is pressed, the available recording formats are shown: 1 grid, 2 grid, 4 grid, datalog.

EXIT "EXIT" in either of the datalog submenus returns the recorder to the TIMER SETUP display.

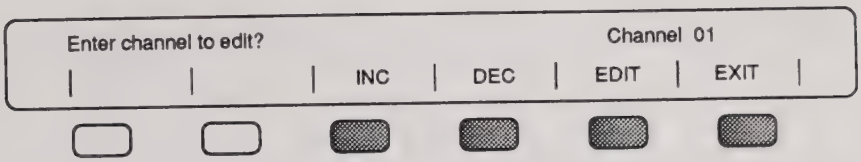
(EDIT) Key



The [EDIT] key is used to select an interchannel buffer and edit the contents of the buffer. Each interchannel buffer is 80-characters in length. Use the [EDIT] key to enter the alphanumeric information of your choice to be printed in the buffer.

(EDIT) Key displays

select channel submenu



Pressing the [EDIT] key invokes the menus required
(1) to select an interchannel annotation buffer for editing and
(2) to edit the content of the buffer.

INC "INC" changes the channel number associated with the buffer to be edited to the next higher channel number. The channel number parameter is automatically selected and blinking when the [EDIT] key is pressed. This indicates that it is ready to be changed.
In addition to the individual channels, the System Log can be selected for editing.

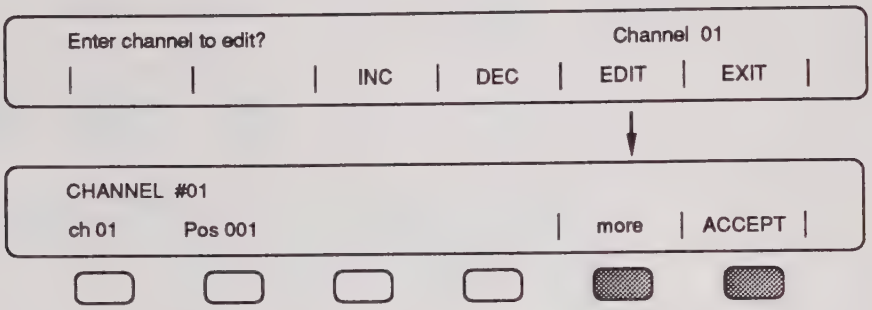
DEC "DEC" changes the channel number associated with the buffer to be edited to the next lower channel number.

EDIT "EDIT" invokes the menu required to access any space within the 80-character interchannel buffer and enter or delete information in that space.

EXIT "EXIT" returns the recorder to the "Enter channel" menu.

(EDIT) Key displays

edit channel submenu



Pressing the soft key beneath "EDIT" causes the menu listing the first forty characters of the interchannel buffer to be displayed. The current contents of the buffer will be listed across the top level of the display. The first character of the display is automatically selected and flashing. This indicates that it can be changed.

The bottom level of the display indicates the number of the channel associated with the interchannel buffer being displayed. The "Pos" (position) parameter indicates the number of the interchannel buffer space (001 - 80) currently selected.

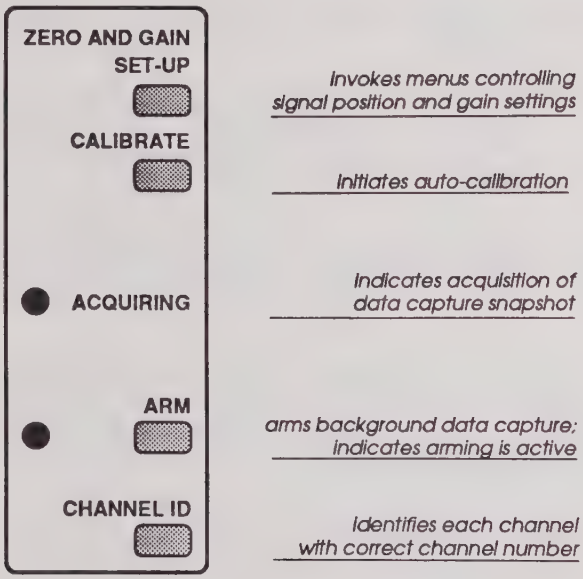
Use the alphanumeric keypad to enter the characters of your choice in the buffer.

- The right arrow key of the alphanumeric keypad moves to the right through each space of the displayed buffer content selecting each character for change.
- The left arrow key of the alphanumeric keypad moves to the left through each space of the displayed buffer content selecting each character for change.
- The [DEL] key of the alphanumeric keypad deletes any currently character. If the [DEL] key is pressed and held, any currently selected character and all characters to its right will be deleted.
- The [INS] key allows you to select any position from within the buffer and insert data from that point.

more "more" calls up the next 40-character spaces of the interchannel buffer.

ACCEPT "ACCEPT" causes the recorder to accept the edited interchannel buffer content. This content will be printed on the chart when the annotation option is selected for the particular buffer. If you do not press "ACCEPT," no change will be made to the current content of the buffer.

Channel Group

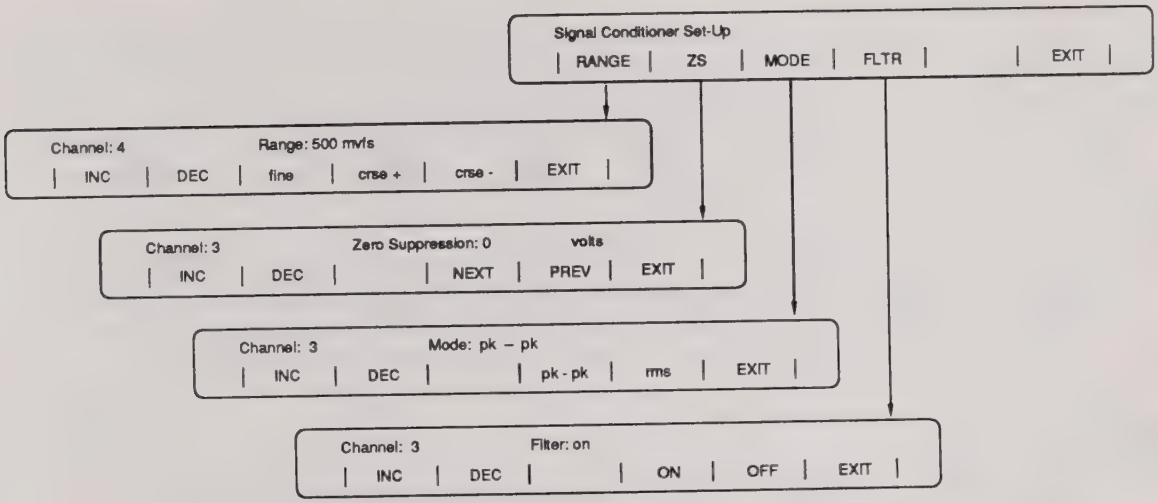

ZERO AND GAIN SET-UP
Invokes menus controlling signal position and gain settings
CALIBRATE
Initiates auto-calibration
ACQUIRING
Indicates acquisition of data capture snapshot
ARM
arms background data capture; indicates arming is active
CHANNEL ID
Identifies each channel with correct channel number

The keys of the Channel Group include: [ZERO AND GAIN SET-UP], [CALIBRATE], [ARM], and [CHANNEL ID]. Together, these keys provide a variety of signal position and gain controls. The function of each key is described below.

The Channel Group also contains two LED indicators:

- the ACQUIRING LED illuminates during a data capture.
- the ARM LED illuminates when background data capture is active (armed).

(ZERO AND GAIN SET-UP) Key



Pressing the [ZERO AND GAIN SET-UP] key invokes the Signal Conditioner Set-up menu. This menu is used to establish the signal conditioning settings your recording requires.

NOTE

Signal conditioner settings and the menus generated by the DASH IV can differ with the kind of Personality Module installed. This discussion is based one of Astro-Med's most widely used Personality Modules: the PM-02. Keep in mind, though, that Personality Modules have differing functions and can generate displays that differ from those presented and explained below.

Signal Conditioner Set-Up submenu

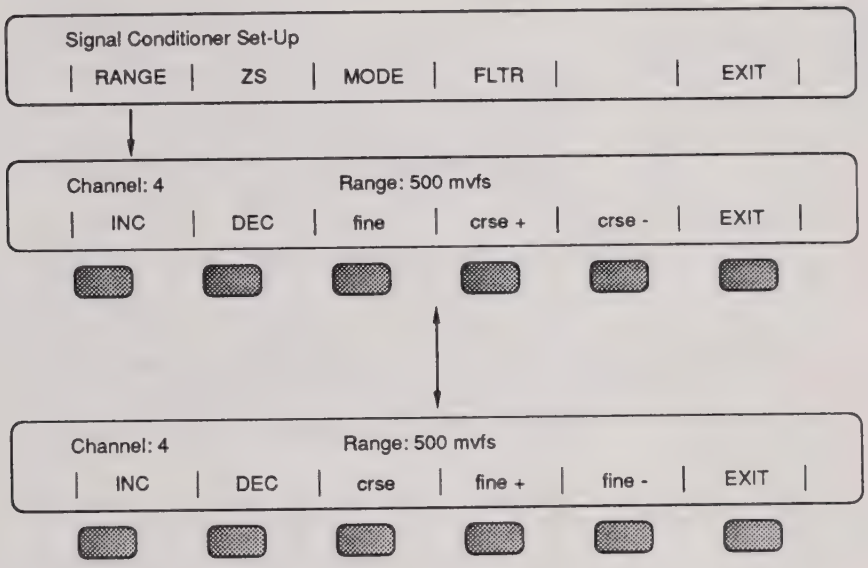
For each individual Personality Module, the Signal Conditioner Set-up menu is used to select the full-scale voltage range, define a zero suppression setting, chose either a peak-to-peak or rms recording mode, and enable or disable the low-pass filter.

RANGE "RANGE" adjusts the full-scale voltage range of the selected channel.

ZS "ZS" adjusts the zero suppression setting of the selected channel.

MODE "MODE" chooses between either Peak-to-Peak or root-mean-square (RMS) recording modes.

FLTR "FLTR" enables or disables the 10 Hz low-pass filter of the selected channel.



INC or DEC

"INC" increases the displayed channel number to the next higher number.

"DEC" decreases the displayed channel number to the next lower number.

fine / fine+ / fine-
crse / crse+ / crse-

The parameter that appears to the right of "DEC" selects either the coarse (crse) range settings or the fine range settings of the full-scale voltage for adjustment. As a result, the parameter toggles between "crse" and "fine" as the soft key is pressed. The figure above shows the two possible displays.

When the parameter reads "fine," pressing the soft key beneath it enables the "fine+" and "fine-" adjustment controls causing "fine+" and "fine-" to appear in the display. When the soft key beneath "fine" is pressed, that parameter toggles to read "crse."

Pressing the soft key beneath "fine+" increases the displayed range.

Pressing the soft key beneath "fine-" decreases the displayed range.

When the parameter reads "crse," pressing the soft key beneath it enables the "crse+" and "crse-" adjustment controls causing "crse+" and "crse-" to appear in the display. When the soft key beneath "crse" is pressed, that parameter toggles to read "fine."

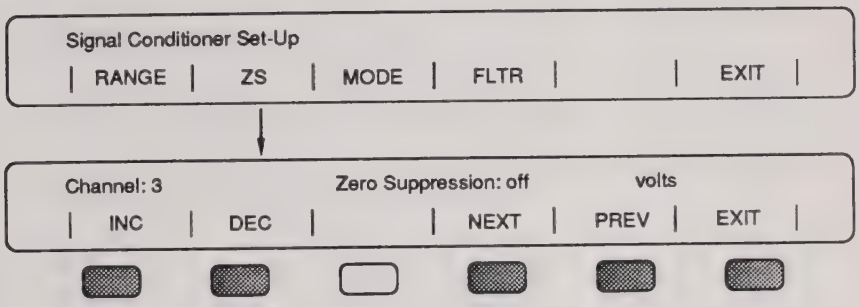
Pressing the soft key beneath "crse+" increases the displayed range in twelve successive increments: 100 mvfs, 250 mvfs, 500 mvfs, 2.5, 5,10, 25, 50, 100, 250, 500.

Pressing the soft key beneath "crse-" decreases the displayed range in twelve successive increments: 500, 250, 100, 50, 25, 10, 5, 2.5, 1, 100 mvfs, 250 mvfs, 500 mvfs.

EXIT

"EXIT" returns the recorder to the Signal Conditioner Set-Up display.

Signal Conditioner Set-Up / ZS submenu



Pressing the soft key beneath "ZS" in the Signal Conditioner Set-Up display invokes the Zero Suppression submenu.

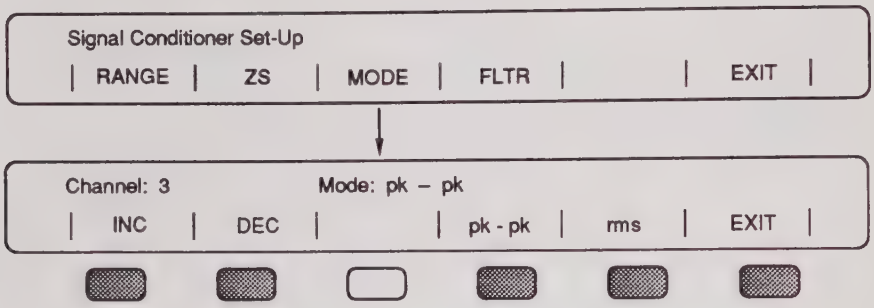
INC or DEC "INC" increases the displayed channel number to the next higher channel.

"DEC" decreases the displayed channel number to the next lower channel.

NEXT or PREV "NEXT" or "PREV" either increases or decreases the displayed zero suppression value in increments dependent on the range.

EXIT "EXIT" returns the recorder to the Signal Conditioner Set-Up display.

Signal Conditioner Set-Up / MODE submenu



Pressing the soft key beneath "MODE" in the Signal Conditioner Set-Up menus invokes the submenu used to specify either peak-to-peak recording or RMS recording of the selected channel.

INC or DEC "INC" increases the displayed channel number to the next higher channel.

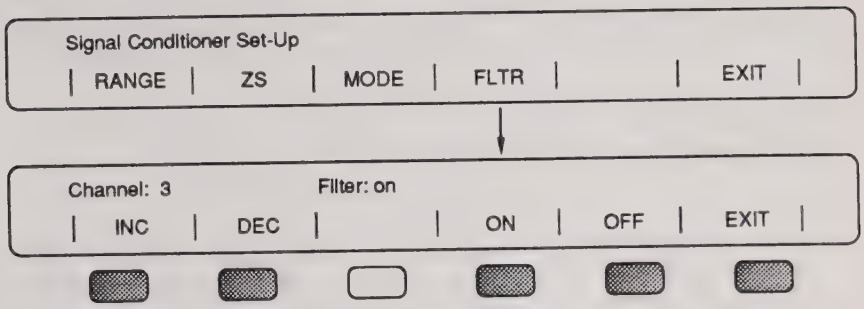
"DEC" decreases the displayed channel number to the next lower channel.

pk — pk "pk - pk" implements the peak-to-peak recording format in the "MODE" parameter.

rms "rms" implements the rms recording format in the "MODE" parameter.

EXIT "EXIT" returns the recorder to the Signal Conditioner Set-Up display.

Signal Conditioner Set-Up / FLTR submenu



Pressing the soft key beneath "FLTR" in the Signal Conditioner Set-Up menu invokes the submenu used to enable or disable the 10 Hz low-pass filter for the selected channel.

INC or DEC "INC" increases the displayed channel number to the next higher channel.

"DEC" decreases the displayed channel number to the next lower channel.

The setting of the "Filter" parameter changes when the channel number changes to indicating the status of the filter for that channel.

ON "ON" enables the 10 Hz low-pass filter for the selected channel.

OFF "OFF" disables the 10 Hz low-pass filter for the selected channel.

EXIT "EXIT" returns the recorder to the Signal Conditioner Set-Up display.

(CALIBRATE) Key

Pressing the [CALIBRATE] key causes the recorder to perform an automatic and extremely accurate gain self-calibration procedure. The self-calibration procedure tests and corrects the baseline offset for each range and channel.

If recording is ongoing:

- waveform output is interrupted briefly.
- the calibration process is performed.
- the chart is annotated with the ground reference and calibration factor for each channel.
- the interrupted recording resumes.

ACQUIRING LED

During data-capture, the ACQUIRING LED illuminates to indicate the acquisition of waveform data.

ARM LED

When background data capture is not active, pressing the soft key beneath ARM enables background data capture. The associated LED illuminates indicating that background data is armed.

When background data capture is active, pressing the soft key beneath ARM disables background data capture. The associated LED shuts off indicating that background data is not armed.

Background data capture is a powerful capability that allows data acquisition to occur "in the background" without interrupting on-going real-time recording.

Pressing the soft key beneath ARM implements background data capture. An LED associated with the ARM soft key illuminates when background data capture is active.

When a background data capture occurs and the DATA CAPTURE PLAYBACK parameter of the SET PBACK setup is set to "auto," the captured data will be played back immediately and automatically.

When a background data capture occurs and the DATA CAPTURE PLAYBACK parameter of the SET PBACK setup is set to "manual," the following display results.

If a data capture occurs when the recorder is operating in a real-time recording mode, the message will be briefly displayed. Ongoing real-time recording is not interrupted with consequent loss of real-time data.

It is important to be aware of the following characteristics of background data capture.

- Background data capture must be armed in order for it to be used during recording.

- If the ACQ ARM menu of the SET ACQ setup is set to manual rearm ("manual — rearm"), then background data capture is not armed when real-time recording is entered. In this case, you need to arm background data capture through the [ARM] soft key.

- When background data capture is armed, data immediately and constantly flows through the circular data-capture memory buffer. Therefore, arming background data capture immediately flushes any data already in the buffer. The flushed data is not recoverable.

  To select background data capture when you are recording in real-time (and "manual — rearm" is selected), press the [ARM] key. This will arm background data capture without leaving the current recording mode. If a data capture should occur, the data capture activity will take place without interrupting the on-going real-time recording.

- Remember that if you (1) select ARM, (2) leave the current recording mode, and (3) re-enter the same or any other mode, then background data capture is automatically disarmed. When you leave and re-enter a real-time recording mode, you need to press the [ARM] soft key to re-activate background data capture.

- Background data capture is disabled by pressing the [ARM] key when the background data capture function is already active. The LED associated with the [ARM] key will extinguish.

(CHANNEL ID) Key

When the recorder is operating in any non-overlapped real-time mode and the [CHANNEL ID] key is pressed, a channel identification number is immediately printed in each channel. The digit that is printed is the number of the channel. This feature is especially helpful if the channels have been rearranged and are no longer in numerical order.

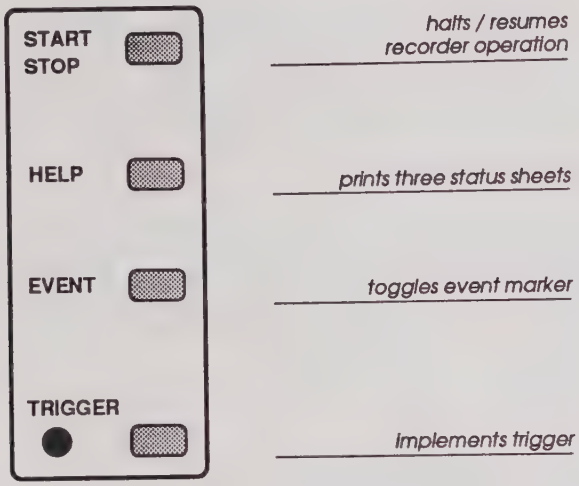
When the recorder is operating in an overlapped mode and the [CHANNEL ID] key is pressed, a channel identification number is immediately printed on each waveform. The digit that is printed is the number of the channel. The value of this feature in identifying overlapped data is obvious.

(BASIC RECORDER RUN) Key

begins immediate 4-channel real-time recording

Pressing the [BASIC RECORDER RUN] key causes the recorder to immediately enter 4-channel real-time recording. Recording setups will reflect the most recently defined settings.

Operation Group

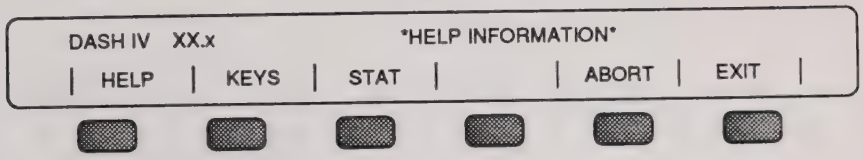


The Operation group consists of four keys labeled [START/STOP], [HELP], [EVENT], and [TRIGGER]. Each of the Operation group's four keys has an immediate affect on ongoing recorder operations. The functions of each key are discussed on the pages that follow.

(START / STOP) Key

Pressing the [START / STOP] key halts and re-initiates recorder printing. Use the [START / STOP] key when you want to pause the recorder.

(HELP) Key



HELP "HELP" results in the immediate printing of a QUICK START GUIDE TO OPERATION.

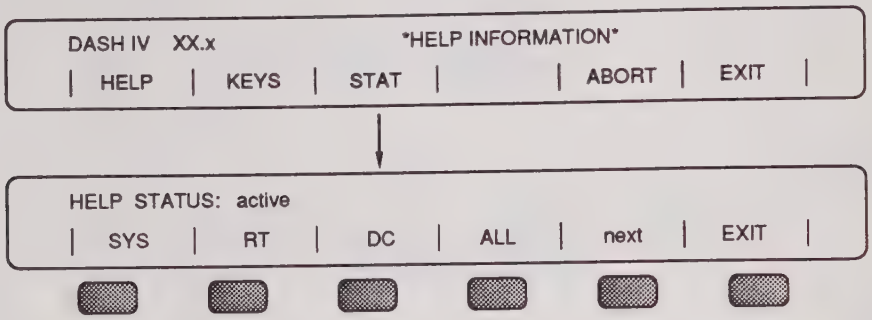
KEYS "KEYS" results in the immediate printing of a GENERAL KEYPAD INFORMATION sheet.

STAT "STAT" invokes the menu used to specify printout of current system setup parameters or the parameters of any of the three system setups stored in the RECALL group's MEM keys.

ABORT "ABORT" immediately stops the printout of any ongoing HELP or status sheet information.

EXIT "EXIT" returns the recorder to its base display.

STAT submenu



Pressing the "STAT" soft key invokes the menu used to specify printout of current system setup parameters or the parameters of any of the three system setups stored in the RECALL group's MEM keys.

SYS "SYS" results in an immediate playout of current system parameters.

RT "RT" results in an immediate playout of current real-time recording parameters.

DC "DC" results in an immediate playout of current trigger, acquisition, and playback parameters.

If the Data Capture option (DC-45) is not installed in your recorder, this parameter will read "TRIG." In this case, the resulting playout will consist of current trigger settings.

ALL "ALL" results in an immediate, comprehensive playout of all system, real-time, trigger, data capture, and playback parameters.

next "next" selects the system setup about which status information will be obtained. The key enables you to select from four system setups: active, MEM 1, MEM 2, MEM 3. The MEM selections pertain to the three system setups that the DASH IV is capable of storing in memory.

EXIT "EXIT" returns the recorder to its base display.

(EVENT) Key

The recorder automatically prints an event marker along the left edge of the chart paper. Pressing the [EVENT] key causes the recorder's this event marker to deflect to the left to mark data of interest to you. The event marker remains deflected while the [EVENT] key is pressed and returns to its undeflected state when the key is released.

(TRIGGER) Key

Pressing the [TRIGGER] key causes an immediate trigger. When the key is pressed, the associated LED lights indicating that the key is active.

This LED has the broader function of illuminating when any trigger is sensed.

Section 5 Theory of Operation

5-1 System Organization

The operational system of the DASH IV can be divided into three functional groups: system control, data acquisition, and utility processor.

The DASH IV uses two microprocessors to perform its functions. Each microprocessor has its individual memory, support circuitry, and set of tasks. Understanding the roles and interactions of these microprocessors is essential to understanding how the DASH IV operates.

- System Processor

  The system processor is located on the Controller board. This processor provides system coordination, directs the printhead, and maintains the recorder's light bar and RAM card.

- Utility Processor

  The Utility processor is located on the Utility board. The processor controls the front panel user interface, communicates with host computers, maintains the DASH IV's time reference, and controls signal conditioning.

5-2 System Control

System control is made up of those components involved in the overall control of the oscillograph. Central to system control is the system processor: a 16-bit microprocessor and its support circuitry. Located on the Controller board, the system processor coordinates the activities of other system components.

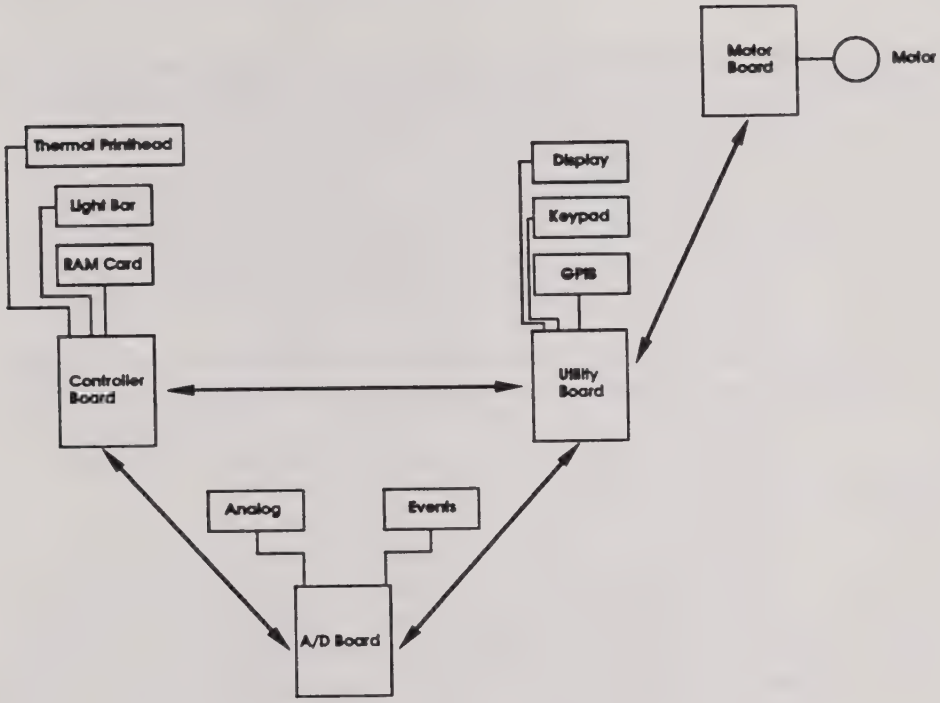
The system processor communicates directly with the Utility processor through a dual RAM port.

The front-panel and the GPIB (IEEE-488) port each provide a means for controlling the operations of the DASH IV. Both interfaces use the Utility board processor to interpret keypad entries and host commands and to respond with appropriate displays. When the Utility processor receives either data or a legitimate command, it transfers the information to the system processor through the dual port RAM.

Tracking user entries is a principal function of the Utility processor. The Utility board uses a lithium battery and low-power RAM to maintain all active system settings and up to 3 complete, alternate system setups.

A separate lithium battery supports a time keeping function by maintaining the Utility board's real-time clock and calendar. Time and date information are supplied to the system controller through the dual port RAM.

Major system components are represented on the opposite page.



5-3 Data Acquisition

As applied to the DASH IV, data acquisition is defined as the conditioning and conversion of analog waveforms to a digital format suitable for recording. This function is performed in the recorder's A/D board which also controls the memory required for data capture. Control signals are transmitted over the system bus from circuitry on both the Controller board and the Utility board.

The DASH IV supports four channels of analog waveforms and up to eight event markers. The A/D board also contains analog trigger detection circuitry. When the analog waveform data has been converted, it is passed by the system bus to the Controller board.

5-4 Principles of Direct Thermal Recording

The DASH IV uses direct thermal recording technology requiring thermally sensitive paper, a thermal printhead, and a method for controlling the energy supplied to the printhead.

The printhead is controlled by the system processor on the Controller board. The system processor converts waveform and text data received from the Utility board and A/D board into a processed data stream compatible with the thermal printhead.

A thermal printhead consists of a series of closely spaced resistive elements mounted on a nonconductive material. This assembly is coated with a protective glaze and mounted on a heat sink. A soft-rubber drive roller or platen holds the thermal paper uniformly against the printhead.

Voltage applied to the printhead's resistive elements causes current to flow and generate heat. The heat is conducted through the protective glaze to the thermal paper. Heat is also conducted to the heat sink on which the printhead is mounted. Thermal paper darkens with the application of sufficient heat. Astro-Med thermal paper marks clearly when exposed to approximately 80° C. Some of the factors affecting the energy required to raise the paper surface to this temperature include paper speed, glaze thickness, paper temperature, and element temperature.

5-5 Strobe Control

Three factors determine the amount of energy applied to each element of the printhead: the voltage across the element, the amount of time the voltage is applied, and the resistance of the element. The DASH IV uses a print voltage of approximately 24 volts. The resistance of the printhead is fixed at approximately 1000 Ohms. The printhead controller regulates the energy flow to the printhead by altering the length of time voltage is applied.

The applied voltage is called the "strobe." The duration for which the voltage is applied is called the "on time" or "strobe length." Each time new data is printed, the printhead is actually strobed twice.

The initial strobe is called the "pre-strobe" to distinguish it from the second pulse. The energy supplied by the two successive strobes is approximately equal to a single pulse of their combined strobe lengths. Application or nonapplication of the pre-strobe is used to compensate for heat build-up within the printing elements. Repeated use of an individual printing element does not allow for a cooling period between strobe cycles. Consequently, successive strobes can raise peak temperatures within an element to damaging levels.

To prevent damage, the controller has special circuitry that monitors the energizing history of all of the individual printing elements. This circuitry prevents the pre-strobe from being applied to elements that have not cooled sufficiently from the previous strobe cycle.

The printhead controller also monitors the temperature of the printhead itself by means of a thermistor mounted within the printhead. Paper speed and printhead temperature are then used to determine the width of the second pulse.

5-5 Strobe Control (continued)

Software is also used as a mechanism for energy regulation. The recorder employs a waveform history algorithm to reduce the energy applied to the printhead when high-speed waveforms are recorded. This reduces the possibility that excessive printing in one channel will drain the power supply and affect recording in other channels.

The instantaneous current required for the printing of high-frequency waveforms can be significant. A high-capacity, low-resistance capacitor is mounted close to the printhead to supply this current. The capacitor is recharged between strobe cycles.

5-6 Interlock

A mechanical switch is mounted just above the paper tray. When the paper-chamber door is closed and the thermal paper is properly loaded, the switch is closed. The switch position is converted to a logic level that indicates either "door open" or "no paper." The utility processor monitors the interlock level and causes an alarm to sound. The logic level is also used to gate the printhead strobe pulses. This ensures that the printhead will not be energized during an interlock condition.

5-7 Time Base Resolution

When recording real-time waveforms, resolution in the time axis is determined by a combination of chart speed and the frequency with which new information is supplied to the printhead. This frequency is called the writing rate or print rate. The DASH IV has a maximum print rate of 1600 Hz.

Typically, resolution in the time axis is specified in terms of the number of times waveforms are updated per each millimeter of chart paper. At chart speeds up to 100 mm/sec, the recorder adjusts the writing rate to provide a resolution of 16 updates per millimeter. A writing rate of 1600 Hz is required to achieve this resolution at 100 mm/s (16 x 100 = 1600). The time base resolution for speeds in the range of 101 mm/sec through 200 mm/sec is fixed at 8 updates per millimeter.

5-8 Annotation

The DASH IV provides four types of chart annotation:

- line printing
- rotated line printing
- channel annotation
- waveform ID

The system uses rotated line printing to generate HELP and STATUS information. Rotated line printing is used to annotate calibration.

The recorder's channel annotation capability can be accessed either through the front panel or through a host computer. A text buffer containing space for 80 characters is provided with each waveform channel. An additional 40 characters are used for recording "talking" signal conditioner settings.

5-9 Signal Conditioning

Each input channel of the DASH IV consists of

- a Personality Module from the PM series of signal conditioners.
- signal conditioning circuits on the A/D board.

Each Personality Module contains a "function" section unique to its operation and a programmable gain section. Each module produces an analog voltage that is sent to the A/D board.

Fine gain adjustment is provided by a programmable attenuator stage located on the A/D board. This circuitry is controlled by the Utility processor.

To prevent aliasing of very high frequencies, the analog input circuitry contains an anti-aliasing filter and a user-selectable 10Hz low pass filter.

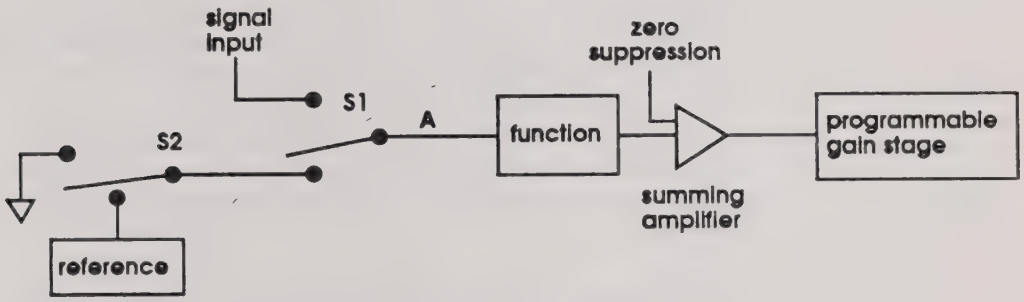
Baseline offset adjustment is provided by a digital to analog converter (DAC) under the control of the Utility processor. The DAC is 12-bit and allows more than 4000 adjustment steps. In all modes, this provides offset control to the dot level ($\frac{1}{8}$ mm). The offset voltage is bipolar and is added to the conditioned signal which is also bipolar.

The offset and conditioned waveform then goes to the trigger sense circuitry. A final stage uses level shifting to change the waveform from a bipolar signal to a unipolar signal. The final stage is required because of the 0 to 5V input range of the A/D converters.

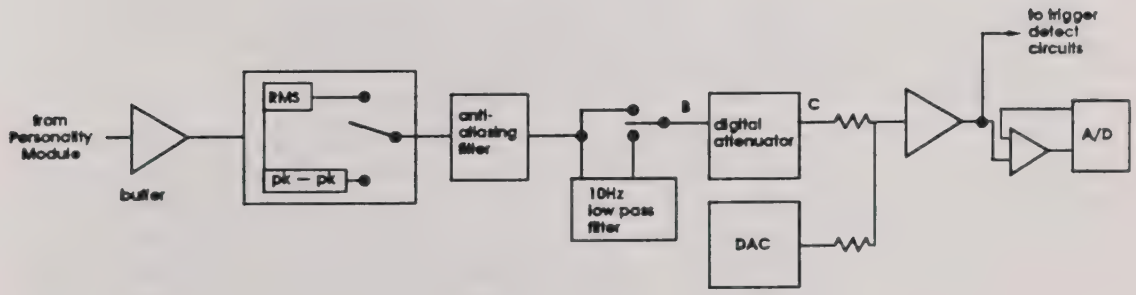
5-10 Calibration

Upon user request, the recorder's programmable attenuator stage and a reference source located on the Personality Module are used by the system processor to perform an automatic gain calibration. The calibration process tests and corrects baseline offset on every range and channel. The components used to implement this process are shown below.

typical Personality Module



built-in hardware



For each input channel, the system processor maintains a record of the most current offset corrections and most current gain correction factors. Each time the [CALIBRATE] key is pressed, these data are recalculated. In order to return the system to the same state, the recorder saves the value of the current range before it begins a calibration cycle.

The typical calibration cycle begins when a zero reference is applied in place of signal. The zero reference varies with the Personality Module. For example, the zero reference for the PM02 is 0 volts. The DAC is also set to 0 volts by the system processor. In the ideal case, the system processor would then read a value of 2048 from the A/D converter. This would indicate that the input voltage was at the exact center point of the range which corresponds to the center point of the chart. Because of the various voltage offsets that can accumulate in any analog circuitry, the processor will generally read something other than the ideal value.

The difference between the actual A/D reading and the true center of range is saved as the offset correction for the particular channel and range. Because analog offset error may vary with range, this calibration cycle is performed on every range. In each case, the offset error is saved. From this point, offset is corrected by using the DAC to compensate so as to ensure that the center of each A/D range corresponds to zero reference. For some Personality Modules, calibration places the the zero reference on the right edge of the chart.

By using the programmable gain capabilities of the PM, the utility processor then sets the range to an appropriate value. The correct offset (as determined in the previous step) is then supplied by the DAC, and a reference is applied. If the gain has been correctly set, the reference produces a precise A/D reading (i.e., on the left edge of the grid). The system processor adjusts the digital attenuator until the A/D reading is correct. The required attenuator setting is then memorized.

5-10 Calibration (continued)

In the case of the PM02, the reference is 2.5 volts. The reference can vary with the Personality Module. The Frequency-to-Voltage Personality Module (PM-12) uses a frequency reference.

Each channel is independently corrected but there is only one gain correction factor per channel. It is assumed that changing the range has no significant effect on this correction factor.

Because each range and channel are checked separately, offset error correction is extremely accurate.

The accuracy of gain calibration depends on three factors:

- the accuracy of the reference.
- the precision of the digital attenuator.
- the variation in gain accuracy from range to range.

The accuracy of some Personality Modules may include other factors.

The reference voltage sources used by the Personality Modules of the DASH IV are precision devices based on the "bandgap" principle which produces a very stable voltage. At room temperature, output voltage is accurate to within 0.1% with a maximum deviation of 10 ppm/°C.

The digital attenuator has 100 steps. The attenuator is in series with a resistor resulting in a gain change of approximately 0.8% per attenuator step. This forms the upper limit on the system's ability to correct for gain variations.

5-11 Real-Time Analog Recording: Data Acquisition

The paragraphs that follow discuss waveform sampling, the min/max recording approach, and frequency response.

Waveform Sampling

The DASH IV records analog waveforms by (1) sampling the waveforms at high speed, (2) converting the samples into line segments, and (3) printing these segments on the chart. The circuitry that controls waveform sampling can be described as a "state machine." This refers to the fact that the circuit is driven from one state of operation to the next at a fixed clock rate.

The data acquisition cycle is based on a 20 MHz clock. Each state lasts 0.05 micro-seconds. Each of the four channels requires 20 states to complete the data acquisition process. As a result, the four channels of the A/D board can be acquired in 4 micro-seconds. This provides a sample rate of 250 kHz per channel.

Each channel has a 12-bit successive approximation A/D converter. All converters share a common data latch and are read sequentially.

Min / Max

The min/max process emulates an ideal pen recorder or oscillograph with a very high frequency response. When recording high frequencies at low chart speeds, this ideal device draws lines between the maximum and minimum input values. A pulse train appears as a sequence of lines. A sine wave appears as a solid band. Signal amplitude is reproduced correctly regardless of paper speed.

In a similar manner, the DASH IV recorder reproduces a waveform as a series of lines printed very close together. The resulting waveform has the appearance of a waveform produced by a traditional pen recorder having a very high frequency response.

The min/max process is implemented by the state machine. When a channel has been sampled, the result is compared to the previous maximum value for that channel. If the newly sampled data point is larger than the previous maximum value, the new data point becomes the new maximum value. Similarly, minimum values are compared and replaced with smaller values as they are sampled. Data points that do not exceed maximum or minimum values are discarded.

Min/max data points are computed over a relatively short time period. Old maximum and minimum values are reset to the current value of the waveform at the beginning of the time period. Therefore, the min/max pair defines changes in the waveform over only a brief time period. Frequently, the maximum value will equal the minimum value. This indicates that the waveform did not change significantly during the period of interest.

As each line is drawn, the DASH IV system processor concurrently:

- collects the current min/max pair, and
- resets the min/max pair to the current waveform value.

Consequently, each line represents only the change in the waveform that occurred from the time that the last line was drawn. For slow changing waveforms, only a point is drawn for many of the cycles because the maximum and minimum values are usually equal. High frequency events are sensed and recorded even at very low chart speeds. Frequency response is not dependent on the writing rate which varies with speed.

5-12 Amplitude Resolution

The level of detail that can be seen or "resolved" on the chart is referred to as resolution. Resolution should not be confused with frequency response. Frequency response describes the ability of the oscillograph to respond to a changing input. When discussing older-technology pen recorders, resolution is usually described in terms of trace thickness and the speed of the chart. In practice, resolution is also influenced by the system's linearity.

Chart speed, linearity, and a factor similar to trace width also influence the resolution of new-technology oscillographs. The trace-width factor depends on the size of the print elements and the distance between print elements. In comparison to the older-technology recorders, the nonlinearity of the DASH IV is insignificant. As a result, the resolution of the DASH IV can be specified in dots per millimeter (dots/mm). The resolution of the thermal printhead is fixed at 200 dots/inch (8 dots/mm).

The recorder uses three standard channel sizes for waveform recording. Channel sizes are designed to maximize the useable range of the DASH IV A/D and optimize the signal to noise ratio. Rounded to the nearest millimeter, the three standard channel sizes are:

- 28 mm (224 dots)
- 56 mm (448 dots)
- 112 mm (996 dots)

Channel size refers to the area covered by the grid. In actuality, the signal's full range exceeds the grid by a distance that varies with the size of the grid.

As received from the A/D's, the data consists of 12 bits allowing for 4096 possible steps over the range. The most accurate representation of the waveform requires a direct correspondence between each step available from the sample and the dots available on the chart. Any other step/dot relationship requires interpolation resulting in some level of waveform distortion.

5-12 Amplitude Resolution (continued)

During real-time recording, the DASH IV does not use interpolation. The 12-bit sample provides more data than required for any of the standard grids. To match sample data to chart requirements, the system processor drops one or more least significant bits.

For example, when 56 mm channels are used, the system processor drops the least significant 3 bits leaving a 9-bit sample. This provides 512 steps over the range of the A/D and leaves 8 steps (0.5 mm) on each side of the channel size.

Another perspective is to consider amplitude resolution as a percentage of full scale. When the 56 mm grid is used, resolution is 0.2% of full scale ($1/_{448}$). If the largest grid size is used, resolution can be increased to 0.1% of full scale ($1/_{896}$).

5-13 Data Capture

The Data Capture option (DC-45) provides the recorder with the ability to increase the time resolution of the recorded waveform. This is achieved by storing sampled waveform data in memory rather than recording the data in real time. Consequently, paper speed no longer acts as the upper limit on waveform resolution. When stored, the waveform information either can be replayed in a variety of formats or transferred to a host computer for analysis.

The A/D board contains most of the circuitry that supports data capture and trigger detection. The DASH IV can capture data without interrupting ongoing real-time recording.

Sample Rate

The data acquisition state machine fixes the sample rate at 250 kHz per channel. Lower samples rates can be selected down to a minimum of 2 kHz. The term "sample window" refers to the time period during which data is captured. The sample window is a product of the number of samples acquired and the time period between each sample. When a lower sample rate is chosen, the time period between samples increases and, consequently, the sample window is increased.

When a sample rate less than the maximum is chosen, the frequency response of the captured data is reduced because the recorder's data capture circuitry saves single points rather that min/max pairs. In general, it is preferable to sample data 6 to 10 times faster than the highest frequency to be observed.

Data Capture Memory

When a RAM card is installed the A/D board has access to 512,000 bytes (0.5 MByte) of dedicated data-capture memory. Data capture memory can only be written to by the data acquisition electronics and can only be read by the system processor.

During data capture, a channel code determines which of the four channels is saved. The data acquisition state machine generates the channel code and sequentially selects the four channels. Latched waveform data from the selected channel is combined with:

- the state of the selected channel's associated event marker.
- the state of the trigger pulse.

A 16 bit word is saved for each sample providing a capacity of 256 thousand samples per board. As each sample is saved, a counter increments the memory location.

Data capture memory is configured as a circular buffer. Data can be acquired even when the buffer is full because the oldest data in the buffer is constantly replaced by the newest data entering the buffer.

By specifying certain parameters of the data acquisition state machine, the system processor regulates several aspects of data capture. Until a trigger is detected, data can be acquired indefinitely.

The post-trigger count determines the number of sample points collected after a trigger occurs. This determines the relationship between the sample window and the trigger event.

As an alternative to dividing acquisition between four channels, the system processor can cause the state machine to allocate all 256 thousand sample locations to only two channels, providing a larger window for the captured channels.

To calculate min/max values, the state machine always samples waveforms at 250 kHz. However, not every sample needs to be stored. The system processor uses a sample rate divider to instruct the state machine to ignore some number of samples. For example, a sample rate divider of 4 causes only every fourth sample to be saved. This results in an effective data capture sample rate of 62.5 kHz. 125 is the maximum useful divider and establishes the lower limit of 2 kHz for a data capture rate.

During playback, the system processor controls the memory a ddress via the system bus and associated buffers.

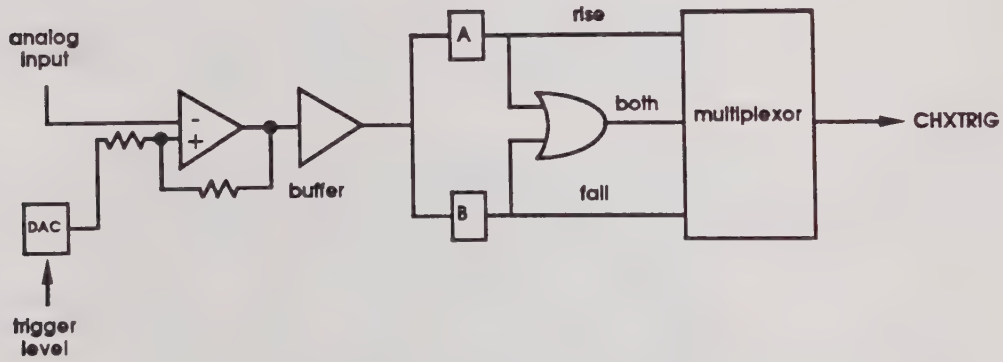
Triggering

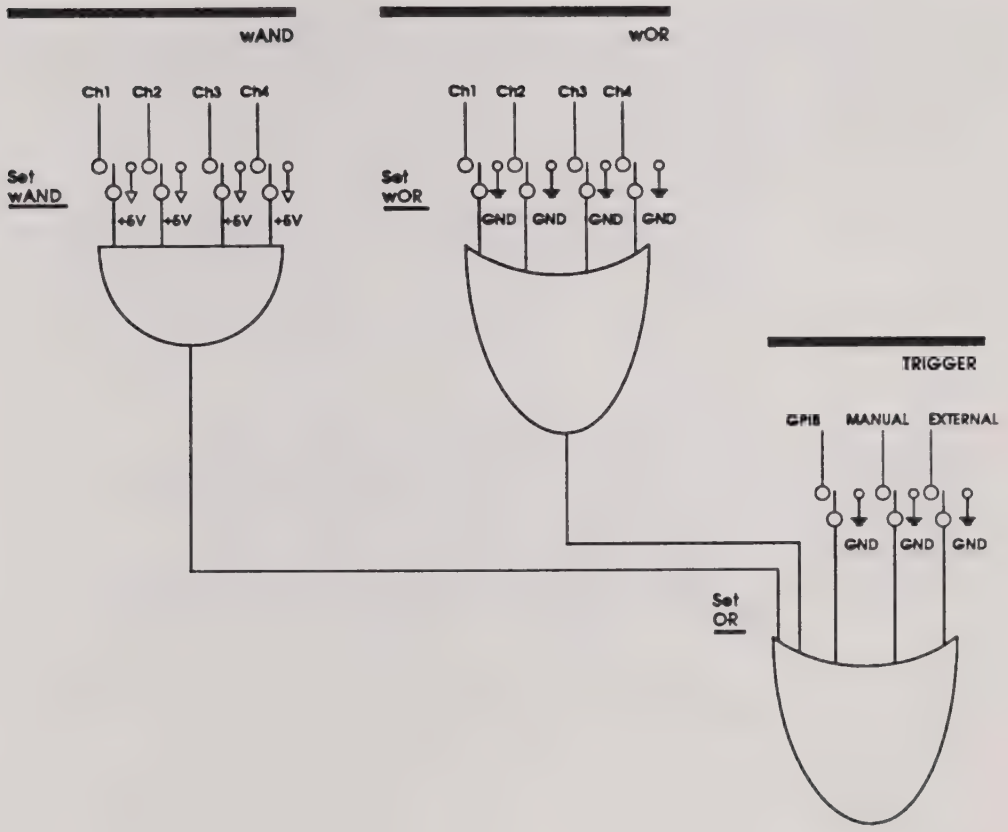
"Triggering" is the mechanism that enables the DASH IV either to begin operation or alter operation in response to various stimuli. Any of the following may constitute a trigger:

- a specific change in any analog input.
- a switch closure or low logic level on the external trigger.
- a pulse on the GPIB trigger line.
- pressing the front-panel manual TRIGGER key.

The triggering process is illustrated in the two figures that follow.

generating a waveform trigger





The result of the triggering process is a pulse on the SYSTRIG line. The triggering pulse can:

- initiate a data capture.
- interrupt one of the processors and prompt it to perform an action, e.g., change recording speed.

One level of "AND" and one level of "OR" logic located on the A/D board and controlled by the Utility processor determines the SYSTRIG source. The trigger can be either (1) set to disabled or (2) set to respond only to those trigger sources that are enabled.

Each analog channel contains a multiplexor and a DAC that, in the desired combination, determine the specific waveform conditions required to generate a trigger. The waveform is compared to a programmable reference level provided by the DAC. The multiplexor can be programmed to:

- produce a trigger when the waveform rises above the programmed reference level.
- produce a trigger when the waveform falls below the programmed reference level.
- produce a trigger when the waveform either rises above or falls below the programmed reference level (both).

In addition, each A/D board can be set to refrain from producing triggers under any conditions (none).

5-14 Time Annotation

The system log is automatically annotated by the recorder with the current time and date. The system log begins with the symbol <. This indicates the point on the chart referred to by the subsequent information. The recorder's real-time clock supplies the time and date information within 0.1 second accuracy. It is important to note that, generally, the < symbol of the system log is not synchronized to any particular time.

5-15 Real Time Clock

A low power real-time clock maintains the time and date. This device divides the frequency of an intrinsic crystal-referenced oscillator and produces a signal at 1-second intervals. The signal updates the time and date and serves as the recorder's time reference. The Utility processor monitors the real-time clock and supplies time and date information to the system microprocessor. A lithium battery backs-up the real-time clock.

5-16 Numerical Recording

The DASH IV is able to record waveforms as a series of numerical values. This is accomplished by taking digitized data from the data acquisition electronics at a rate set by the user. This mode has a particularly useful feature. It rescales the sampled data and presents the converted data as user-defined engineering units.

The data acquisition subsystem provides the raw data as a min/max pair for the period of time since the last sample. This data has 12-bit resolution ranging from 0 to 4096. The calibration of the system is such that the center of this range (2048) corresponds to the center of the recording channel. When the waveform is adjusted to produce a flat line in the center of the grid, the min and max values supplied by the data acquisition subsystem both equal 2048.

This is significant in that a fixed relationship is established between the input voltage and the output of the A/D converter. The datalogger feature takes the value supplied by the A/D subsystem (number of steps) and scales it based on the calibration set by the operator. Scaling is based on the following equation:

$$y = mx + b$$

where: y = scaled result
m = slope
x = A/D value
b = offset

5-16 Numerical Recording (continued)

To specify m and b directly would require a detailed knowledge of the relationship between the A/D output and the input signal. To eliminate this requirement, the user is required to indicate the value of the input signal (in the units desired) at the left side (LS) of the grid and the value of the signal at the right side (RS) of the grid. The system then calculates m = (RS - LS) / grid width. Grid width is the number of A/D steps between the right and left sides of the grid. The value for b is found by computing the center of the chart (c) in user-defined units ([RS - LS] / 2). The value of b is given by:

$$b = 2048 - mc$$

It is important to note that the precision of the printout is limited by the resolution of the A/D converter. This cannot exceed four digits. As a consequence, calibration factors are specified as four significant digits and an exponent. Because all calculations are performed using integers, the exponent is used only to place a decimal point or to add trailing zeros.

5-17 Event Markers

The DASH IV provides a number of event marker inputs. In general, these are specified as operable with a TTL level or switch closure.

The typical event marker input is a TTL gate with a 4700 ohm pull-up resistor. This ensures that the event is off when no signal is connected. The pull-up resistor is connected to the internal 5-volt logic supply. In order to activate the marker, the input must be forced to a TTL low. This requires that the input be less than 0.8 volts and preferably less than 0.5 volts. This is easily done by using a wire or relay to short the input to common. This is the definition of "switch closure operable."

If the source is an electronic circuit, it must be able to sink approximately one milli-ampere (5 volts / 4700 ohms). Any TTL compatible device easily accomplishes this.

The DASH IV supports a maximum of eight event inputs. All event inputs must be TTL or switch closure. Event inputs are processed by a hardware glitch capture circuit. The circuit responds to changes as short as 1 microsecond. All event inputs can be recorded during a data capture and are available for input.

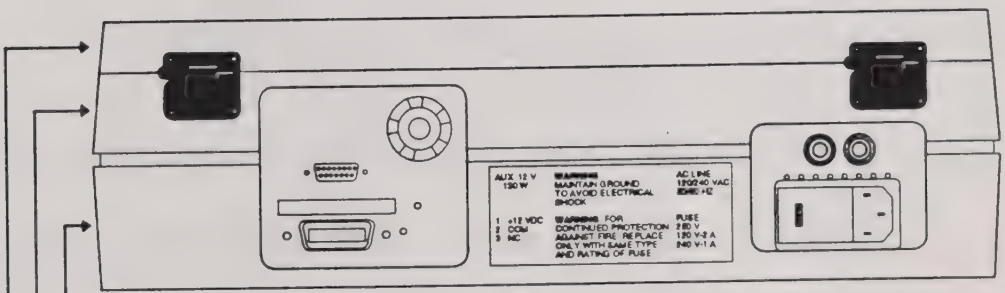
The four standard event markers can be thought of as event #1, event #2, event #3, and event #4. Event #1 is the system event marker. Event #2 records either an external event or the timer. Events #3 and #4 record only external events. Events #3 and #4 are turned on or off through menu commands. Event #5, event #6, event #7, and event #8 are optional and are recorded in place of channel annotation. The user selects whether the channel buffer will contain text, event markers, or nothing at all.

The system event marker (event #1) is OR'ed with the front panel [MANUAL] key. In all waveform modes, the result is recorded just below the system log. Using menu commands, event #2 can be switched between an external event and the internal timer. The timer channel is displayed at the bottom of the chart. Event markers #3 and #4 are recorded directly below the system event marker.

Section 6 Maintenance

6-1 DASH IV Disassembly

For purposes of disassembly, the DASH IV can be thought of as consisting of three sections: bottom, midsection, and top cover.



BOTTOM Contains operating electronics, Personality Module cards, battery pack (if installed), and paper chamber.

MIDSECTION Attached to bottom. Presents operational controls of front-panel interface. Covers internal components.

TOP COVER Contains AC power cord. Easily detachable. Closes and latches to protect operating controls.

6-1 DASH IV Disassembly (continued)

Most of the DASH IV's electronic assemblies are located in the bottom section of the recorder. You may want to access the recorder's internal components if you should desire to:

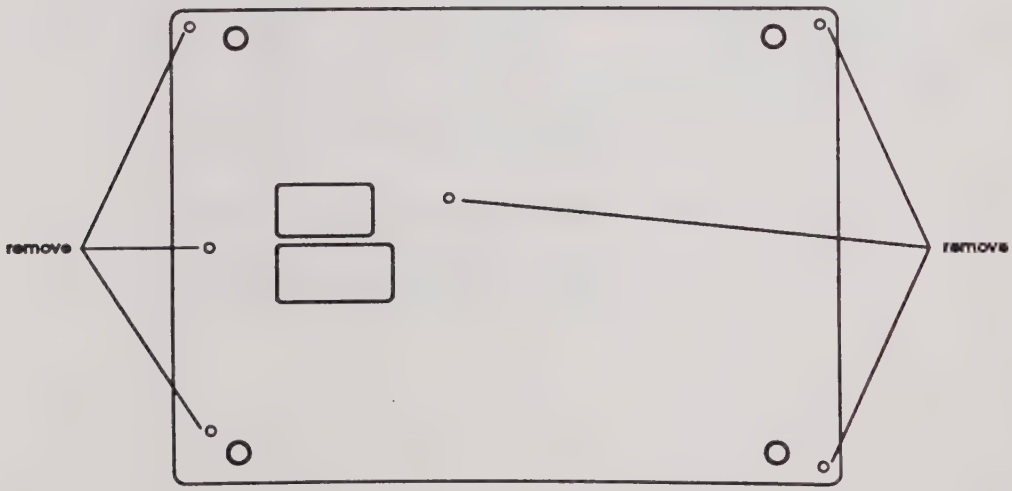
- install or replace a NiCad battery power pack.
- install or replace Personality Modules.

Use the procedure given below to disassemble the recorder case to accomplish either of these tasks.

Separating the Recorder's Three Sections

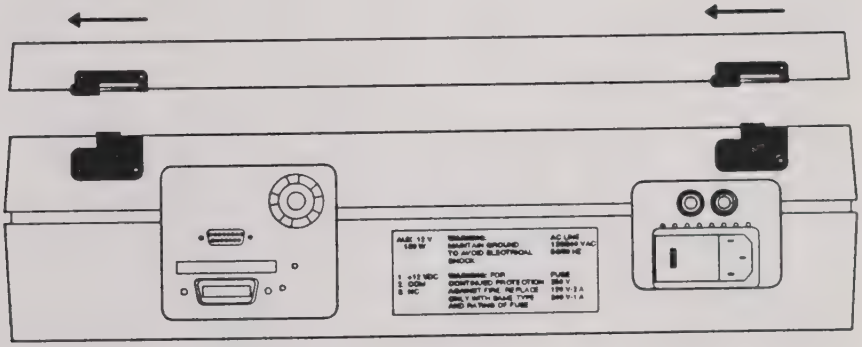
1 Place the DASH IV on its top cover so that the bottom of the recorder is accessible.

2 Remove the six screws that secure the bottom to the midsection.



3 Holding both the top cover and the bottom of the recorder to ensure that the sections remain together, turn the recorder so that it again rests upright on its bottom.

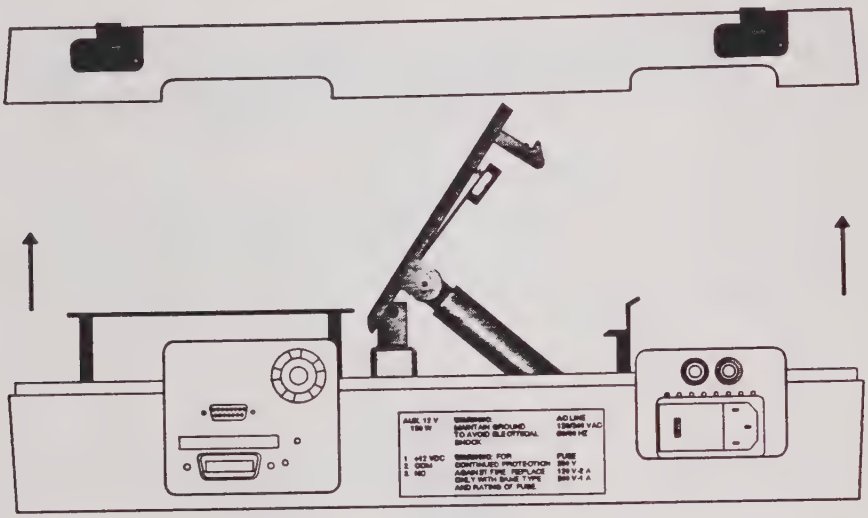
4 Open the top cover and gently tap or push it from the side to release the pull-apart hinges that secure it to the midsection. The top cover will come free. Set the top cover aside.



5 Press the paper-chamber door release to open the door.

Carefully remove the midsection of the DASH IV to expose the inside of the recorder.

The two sections are closely fitted and you may need to "work" the midsection slightly when you remove it. Note that three ribbon cables are attached to the midsection.



6 When the midsection has been removed you will notice three ribbon cables that run from the recorder's bottom section and attach to the interior of the midsection. These are the alphanumeric keypad cable, the LCD display cable, and the cable associated with the remainder of the DASH IV's soft keys.

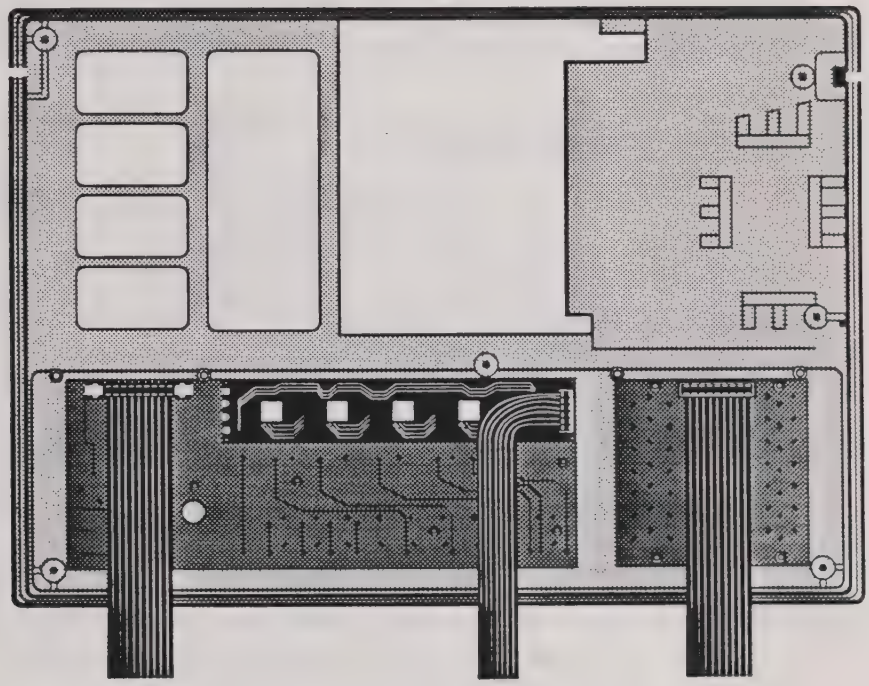
Carefully work each cable free.

Wiring also runs from the recorder's power switch and low-battery indicator light. Unplug these wires at their points of attachment in the recorder's bottom section.

The recorder's midsection can now be removed and set aside.

The three sections of the DASH IV are now separated. Internal components such as Personality Modules or the recorder's battery compartment can now be installed or removed.

Interior of midsection



- cable for front panel soft keys
- cable for LCD display
- cable for alphanumeric keypad

6-2 Installing or Removing a NiCad Battery Pack

This procedure is designed to minimize the amount of disassembly required to access the DASH IV's battery compartment. Numerous connections are left intact. If you choose, you can make additional disconnections. If you make additional disconnections, be sure to write down plug and socket matings for later reconnection.

CAUTION

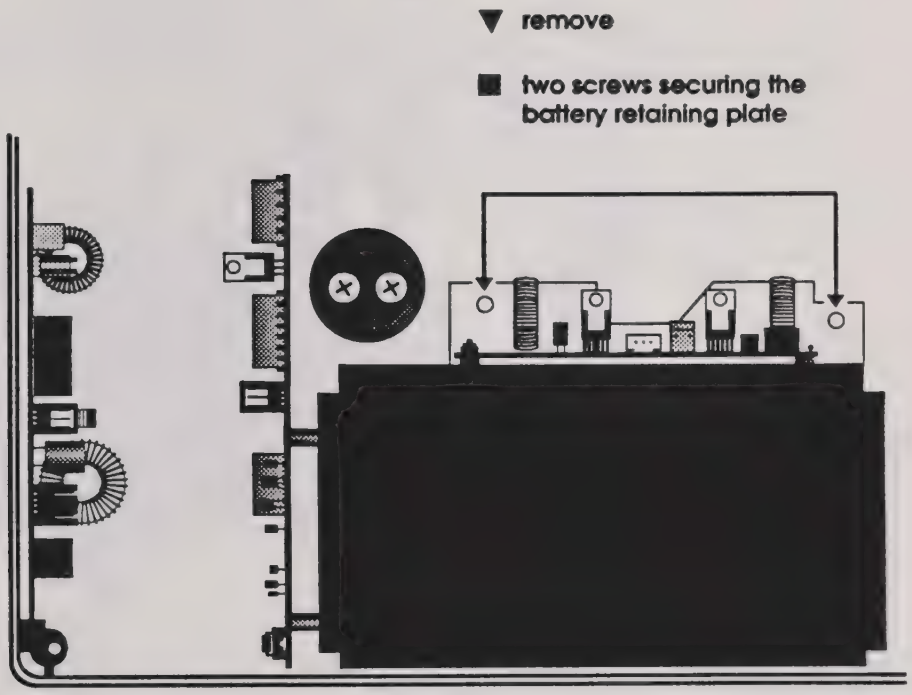
Handle the circuit boards of the DASH IV with great care. Board components are delicately mounted and can be damaged if roughly handled. In addition, ensure that the recorder's wires and cables are never crimped or impinged on during the battery installation/removal process.

1 Disassemble the DASH IV as described above in "DASH IV Disassembly."

2 Looking into the lower left corner of the bottom section of the recorder, locate the battery retaining plate.

Remove the two screws that secure the battery retaining plate to the bottom of the recorder.

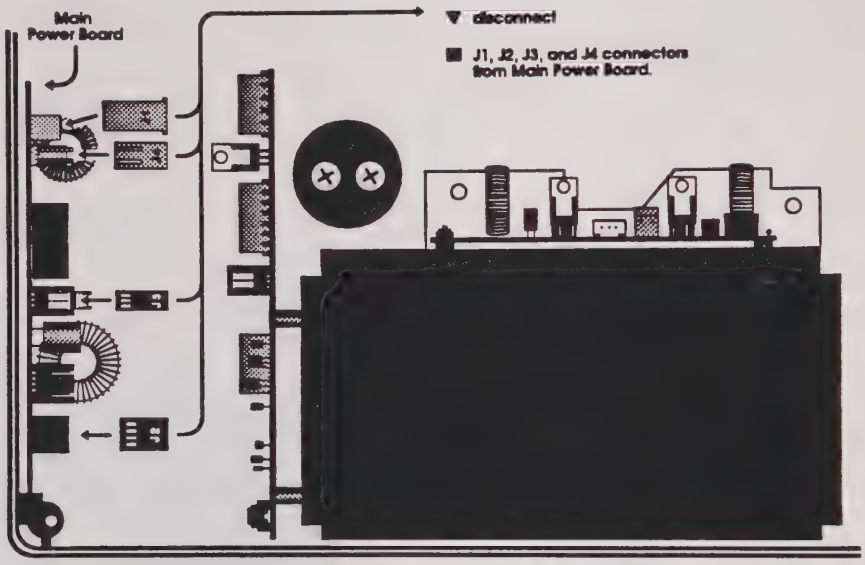
6-2 Installing or Removing a NiCad Battery Pack (continued)



3 Disconnect the J1, J2, J3, and J4 connectors from their respective sockets on the Main Power Board.

The connectors are labeled and are easily accessed along the top of the Main Power Board.

6-2 Installing or Removing a NiCad Battery Pack (continued)



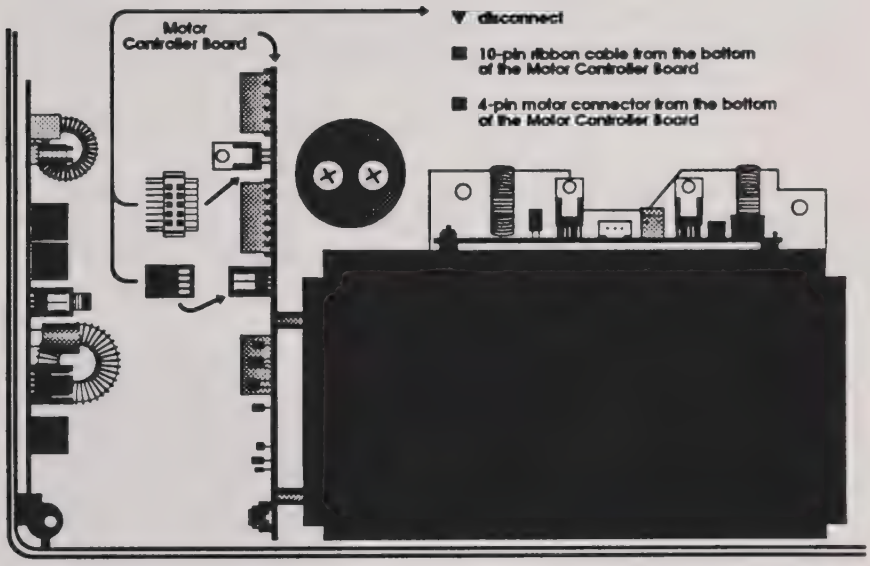
4 Disconnect the 10-pin ribbon cable that attaches near the bottom of the Motor Controller Board.

This is the only ribbon cable connected to the Motor Controller Board.

6-2 Installing or Removing a NiCad Battery Pack (continued)

5 Disconnect the 4-pin plug that connects the DASH IV's motor to the Motor Controller Board.

The connector is located at the bottom of the board and is the only 4-pin connector attached to the Motor Controller Board.


Motor Controller Board
▼ disconnect
■ 10-pin ribbon cable from the bottom of the Motor Controller Board
■ 4-pin motor connector from the bottom of the Motor Controller Board

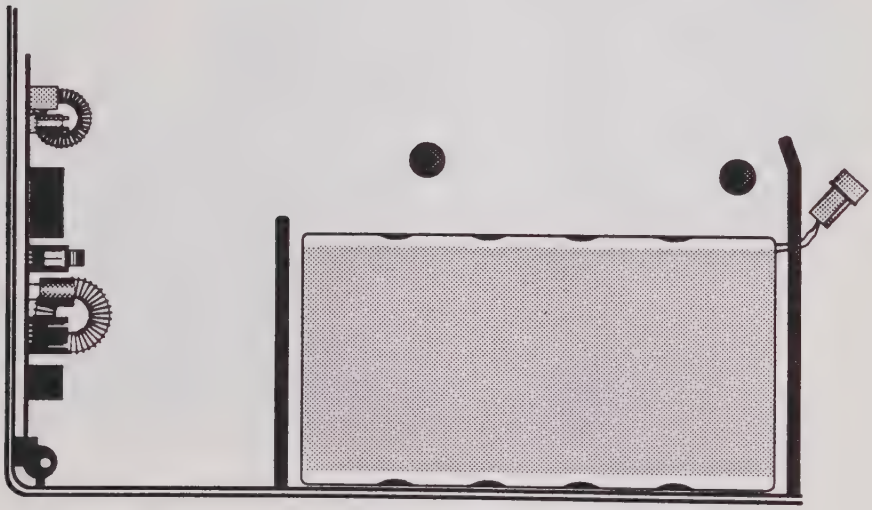
6-2 Installing or Removing a NiCad Battery Pack (continued)

6

Carefully lift the battery retaining plate.

The Motor Controller Board and Analog Power Board remain attached to the battery retaining plate. Ensure that the delicate board-mounted components are not bent or damaged during this process.

Rest the assembly on the paper chamber door. This exposes the battery pack compartment.



6-2 Installing or Removing a NiCad Battery Pack (continued)

7

CAUTION

When installing a battery pack, the battery connector and its wiring fit through the upper right-hand corner of the battery retaining plate. To facilitate this, the plate's upper right-hand corner is an open slot. Ensure that the retaining plate does not obstruct or damage the wiring running from the battery.

To replace or install a battery pack:

- disconnect the leads of any currently installed battery pack from the connector running from the DC harness battery connector. The connector has two wires: one orange and one black.
- remove the old battery pack.
- position the new battery pack length-wise on its side with its connector in the upper right-hand corner.
- insert the new pack in the compartment.
- reposition the battery retaining plate and reinsert the screws that secure it.
- connect the new pack to the DC harness battery connector.

8 Reattach all of the previously unfastened connections.

9 Reassemble the recorder's three sections.

6-3 Personality Module Replacement / Removal

The replacement / installation process described below is based on the requirements of the PM02 Personality Module. Replacement / installation of other types of Personality Modules may differ slightly from the details presented.

CAUTION

Handle Personality Modules and the circuit boards of the DASH IV with great care. Board components are delicately mounted and can be damaged if roughly handled. In addition, ensure that all wires and cables are never crimped or impinged on when replacing or installing a Personality Module.

1 Disassemble the DASH IV as described above in "DASH IV Disassembly."

2 In the upper right-hand corner of the recorder's bottom, locate the plate containing the zero baseline position controls, signal grounding [GND] keys, and signal input connections.

Remove the four screws that secure the plate.

3 Lift and remove the plate. Disconnect the miniature coaxial cables that run from the signal input connections to the Personality Modules. Set the plate aside.

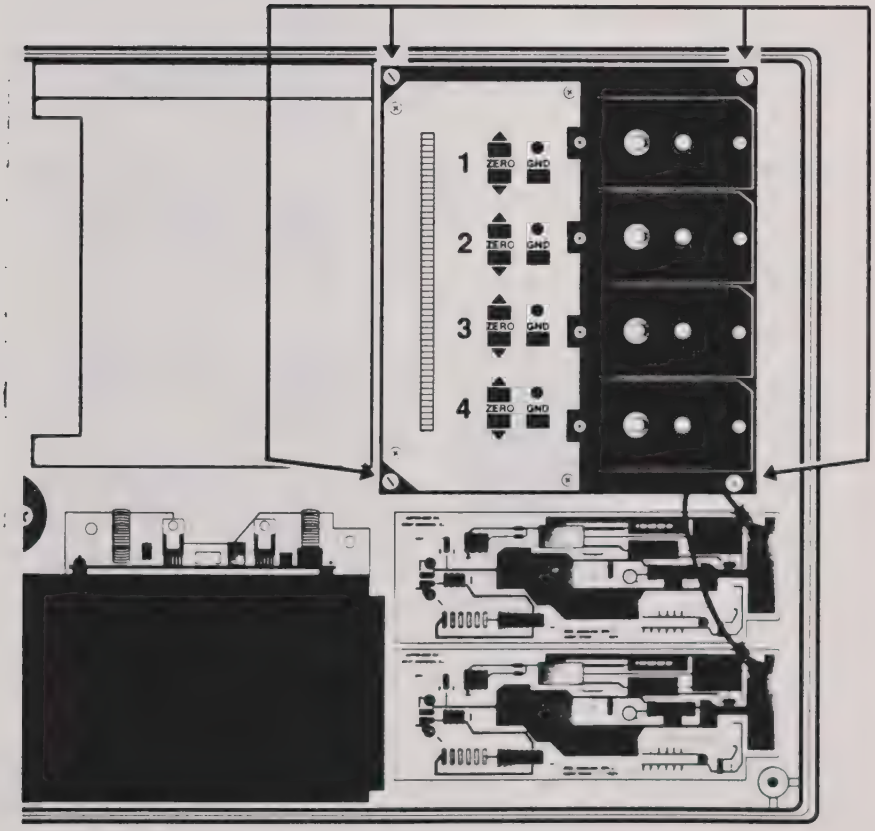
The Personality Modules are now exposed.

You will notice a ribbon cable that connects to the plate. It is not necessary to disconnect this ribbon cable although you can disconnect it if you choose.

6-3 Personality Module Replacement / Removal (continued)

▼ remove

■ four screws securing the plate covering the Personality Modules

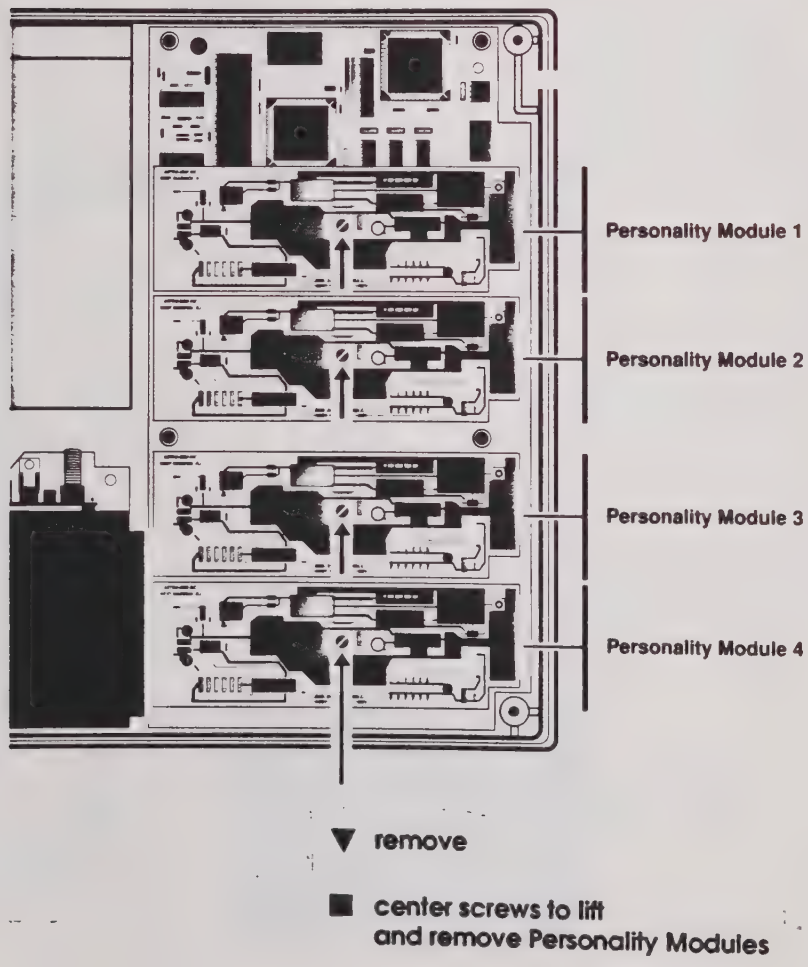


6-3 Personality Module Replacement / Removal (continued)

4

To remove a Personality Module:

- remove the slotted binder-head screw that secures the module in place.
- carefully lift the Personality Module and remove it from the case.



6-3 Personality Module Replacement / Removal (continued)

5 To install a Personality Module:

- Carefully but firmly seat the connectors located near each end of the Personality Module Board into their mating connections on the recorder's A/D Board.
- Use the slotted binder-head screw to secure the Personality Module Board in position.

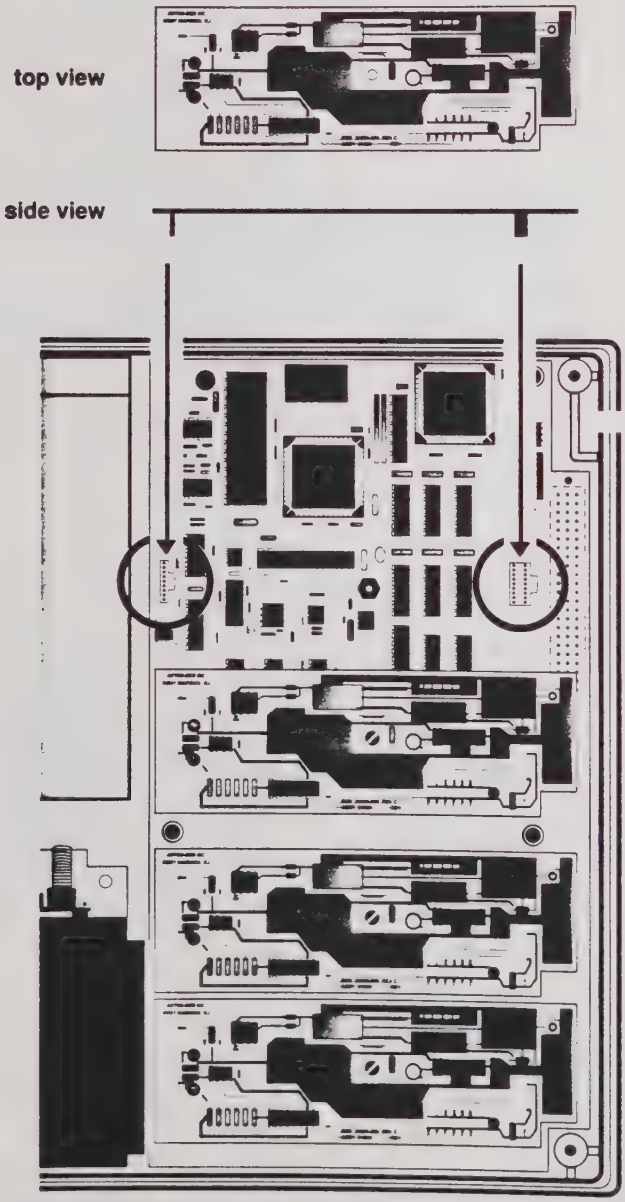
6 Reconnect the miniature coaxial cables that run from the signal input connections to the Personality Modules.

Reinstall the plate containing the zero baseline position controls, signal grounding [GND] keys, and signal input connections.

7 Reattach the recorder's three sections to one another to complete the DASH IV's reassembly.

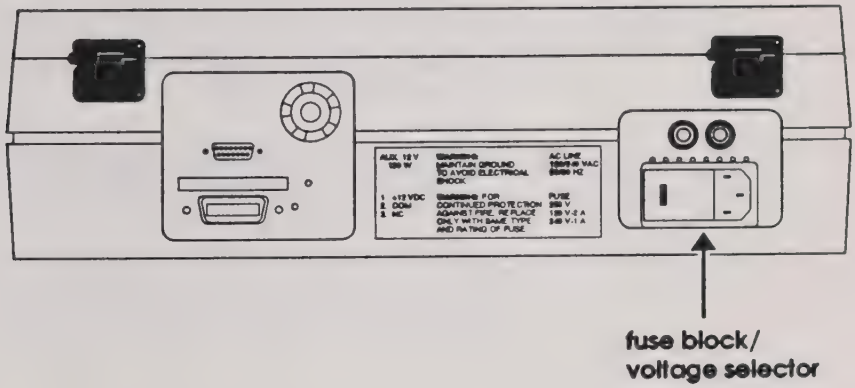
6-3 Personality Module Replacement / Removal (continued)

Installing Personality Modules

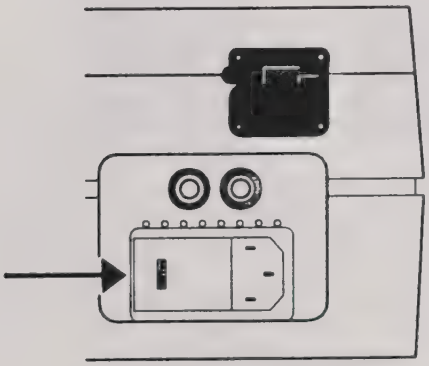


6-4 Fuse Replacement / Voltage Selection

1 On the DASH IV's rear panel, locate the compartment containing the recorder's fuses and voltage selector.



2 Insert a small flat-head screwdriver in the slot beneath the voltage setting indicator to remove the fuse compartment / voltage selector. Remove the compartment by gently prying it free.



▼ Insert

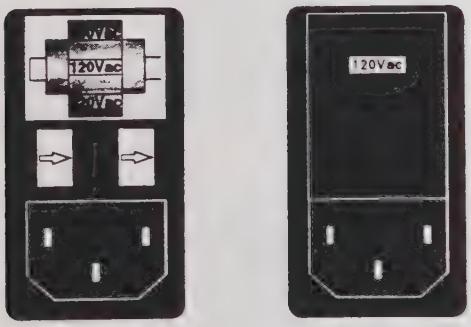
■ flat-head screwdriver in slot to expose fuses

6-4 Fuse Replacement / Voltage Selection (continued)

3 To change the recorder's fuses, remove and replace them as necessary.

To change the operating voltage:

- replace both fuses with fuses appropriate to the voltage that will be powering the recorder.
  - operation at 120 VAC requires two 3.15A fuses.
  - operation at 240 VAC requires two 1.6A fuses.
- remove the voltage-selection cylinder and orient the cylinder so that the appropriate operating voltage appears in the voltage selection box "window."

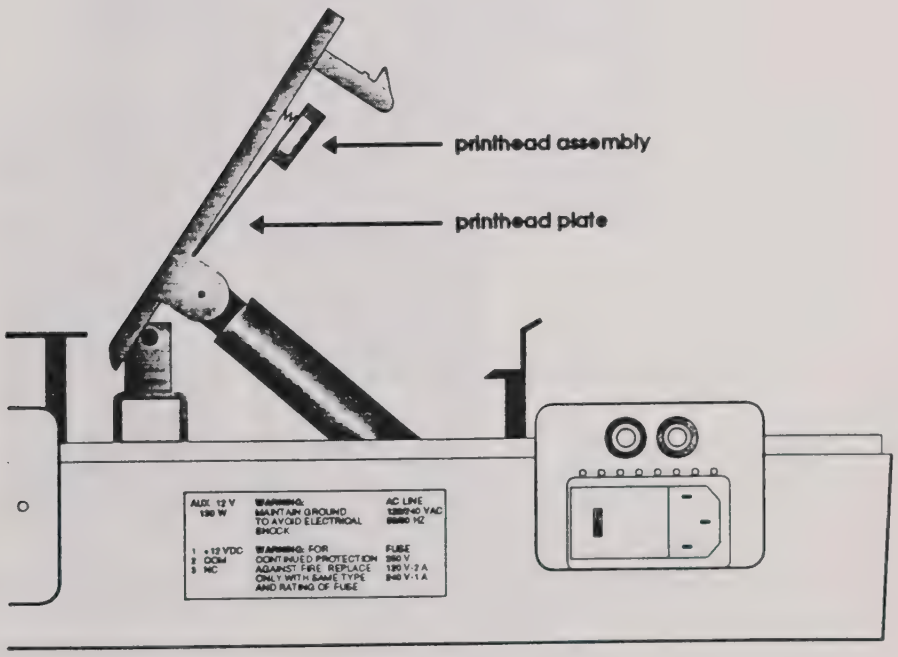


6-5 Printhead Replacement and Adjustment

The DASH IV's printhead is attached to the printhead plate on the underside of the paper chamber door. The printhead is extremely reliable and would only require adjustment or replacement in rare instances. The following procedure describes printhead replacement, adjustment, and cleaning.

1 Remove the recorder's top cover and midsection as described in 6-1, "Accessing the Internal Components of the DASH IV".

2 Locate the printhead plate and printhead on the underside of the paper chamber door.

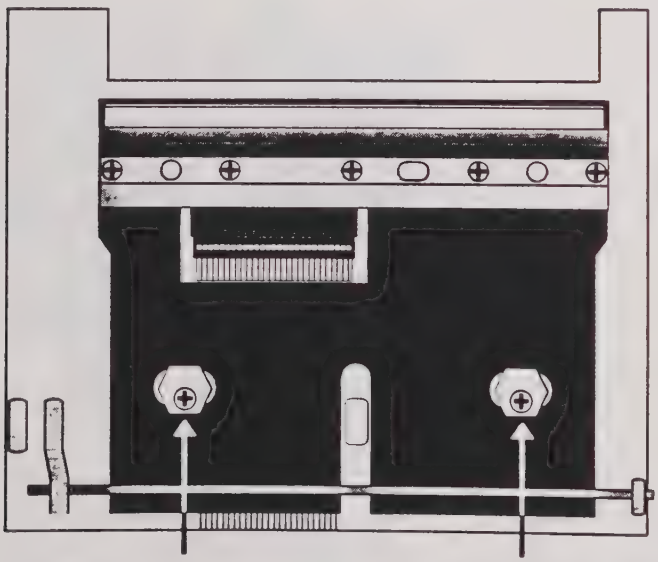


3 Remove the printhead plate with the attached printhead by removing the two Phillips-head screws that secure it to the paper chamber door.

Completely detach the printhead plate by unplugging the ribbon cable that attaches to the printhead.

NOTE

When the printhead plate is removed, two Phillips-head screws, their associated eccentric nuts, and three printhead springs are freed. Ensure that the screws, nuts, and springs are retained and set aside for later reuse in the reassembly process.



▼ remove

■ two Phillips-head screws securing printhead plate

▼ retain and set aside

■ two Phillips-head screws

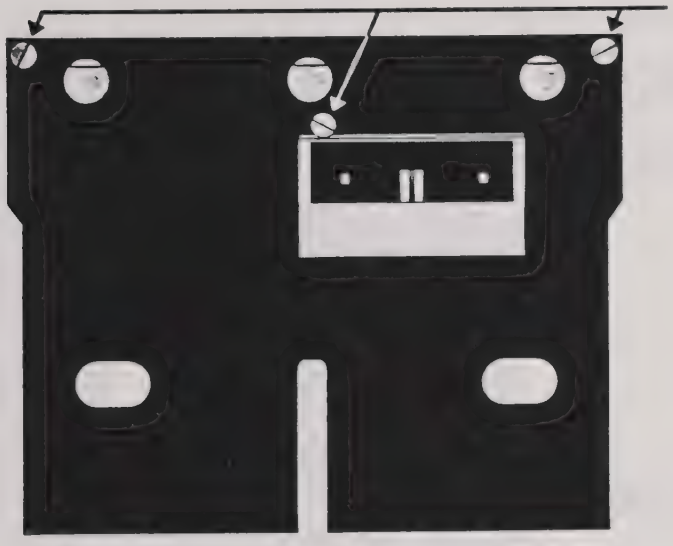
■ two eccentric nuts

■ three springs behind printhead

4

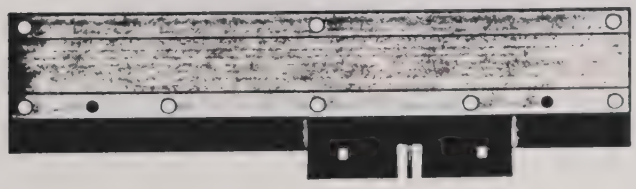
On the rear of the printhead plate, remove the three slot-headed screws that secure the printhead to the plate.

Ensure that the small washers associated with the screws are retained and set aside. Set the removed printhead aside.



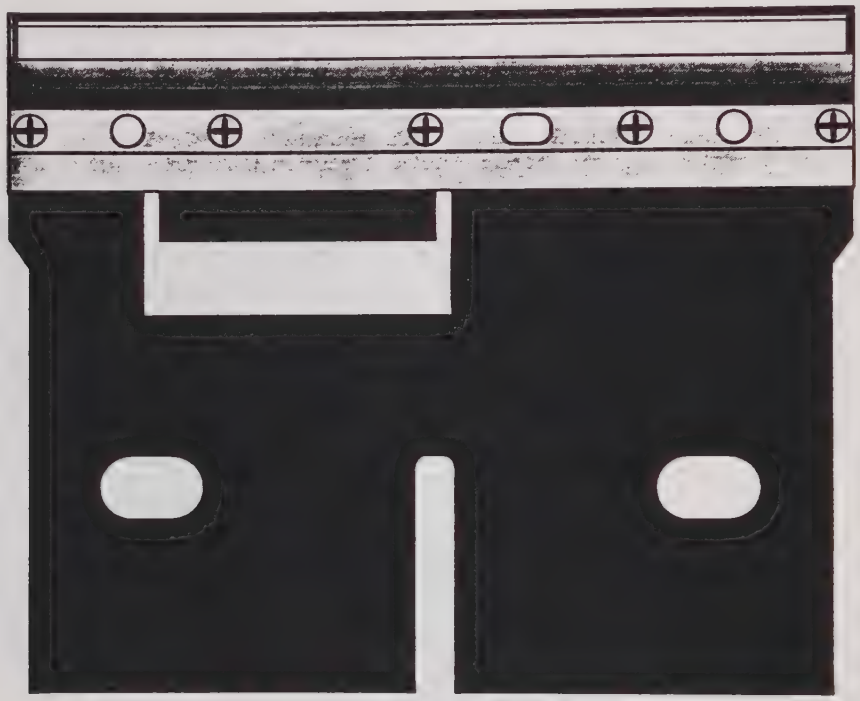
▼ remove

■ three slot-head screw attaching printhead to plate



■ rear of removed printhead

5 Using the screws and washers removed in step 4, attach the replacement printhead to the printhead plate.



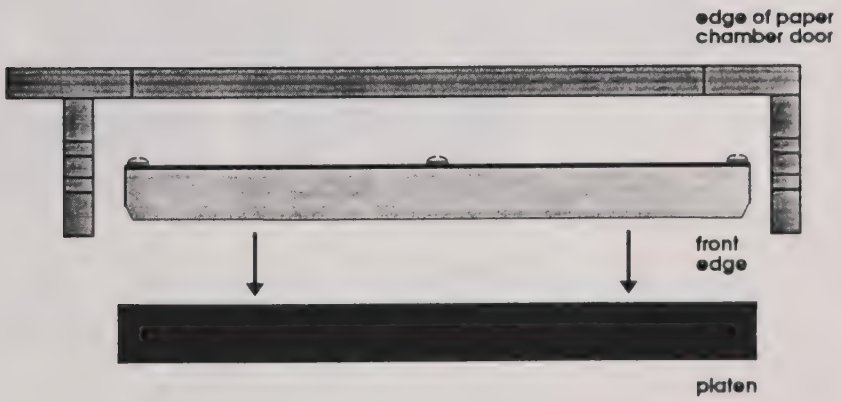
▼ attach

■ replacement printhead to printhead plate

6 Orient the printhead plate so that its thermal printing elements will meet the paper moving platen.

Reattach the ribbon cable to its receptacle on the printhead.

■ front of printhead



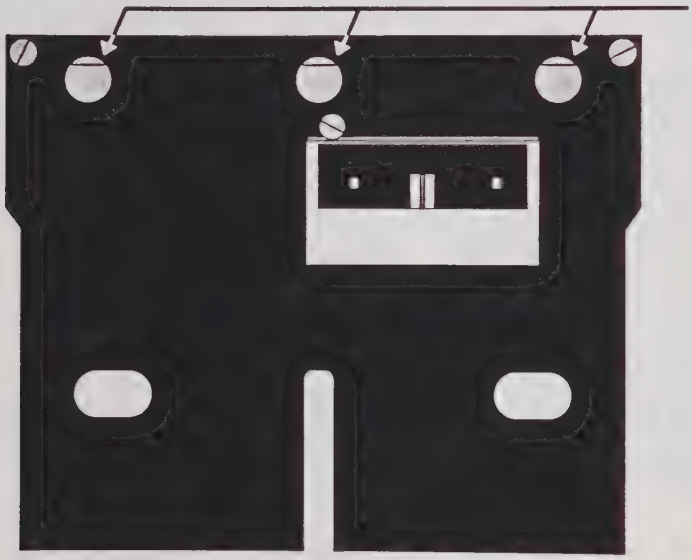
▼ orient

■ front edge of printhead to face platen

7

Insert each of the three printhead springs into the recesses provided on the rear of the printhead plate and the underside of the paper chamber door.

Hold the printhead plate in place against the underside of the paper chamber door keeping the springs under tension.



▼ insert

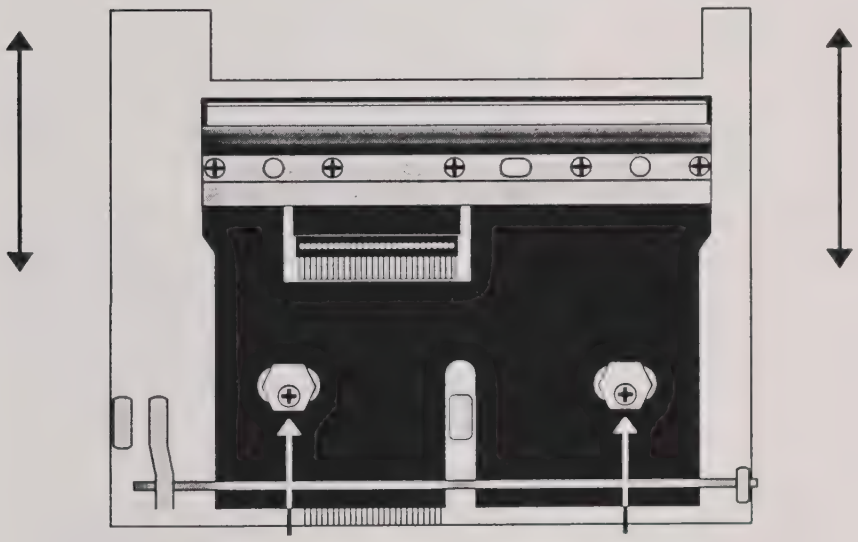
■ three springs into large holes in rear of plate

▼ top view

■ springs inset between door and printhead

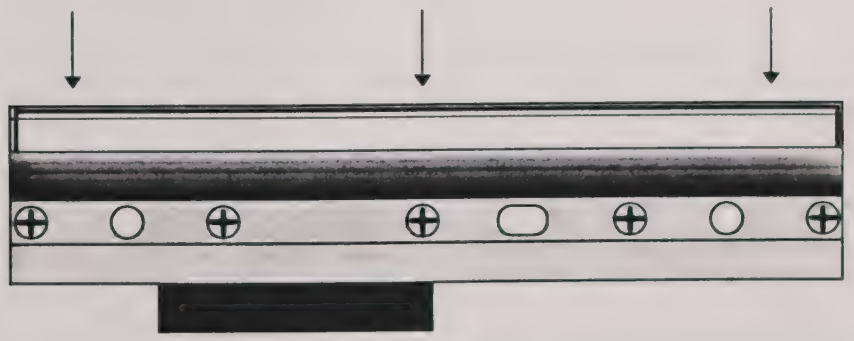
6-5 Printhead Replacement and Adjustment (continued)

8 As necessary, loosen or tighten the two Phillips-head screws that secure the printhead plate to horizontally align the thermal printing elements.



6-6 Printhead Cleaning

1 As necessary, use denatured alcohol and a cotton-tipped swap or soft cloth to clean the surface of the printing elements.



6-7 Replacement Parts

Part	Number
A/D assembly	41716001
analog power supply PC board	31635000
controller assembly	41714001
Data Capture RAM Card	41727512
drive roll	23411000
front panel assembly	41726000
LCD and connector assembly	23626000
light bar driver assembly	41756001
main power supply assembly	31637001
motor drive assembly	31636001
motor step assembly with pulley and connector	22040102
power cord, 18AWG 1650 Watts	10787000
printhead	30995023
rectifier, 25A bridge	11009002
spring, gas, 10lb	23553001
System Software RAM Card	41761000
transformer, 12.6V @10.3A	23518002
Utility board assembly	41715001

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